N4/5

Design and Manufacture

Theory & Homework Support Material

WORKING GROUP HIGHLAND

A collation of resources and homework exercises from colleagues in schools all over Scotland

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N4/5

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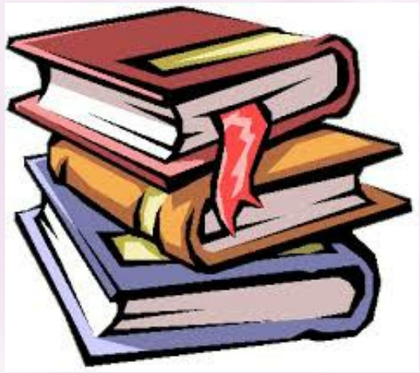
INTRODUCTION

This book has been written to support the work of students and teachers in National 4 & 5 Design and Manufacture. The materials within the book have been gathered from a range of sources and collated into one format. It hasn't all been written by the Highland SLWG. It aims to assist with the delivery of theory and homework tasks.

The pages have been designed for use by both the educator and the student.



HOW to use this book

How you use this book will depend on the school and student needs. It is split into 2 units.

Unit 1 - Design and
Unit 2 - Materials and Manufacturing.

Within each of these units you will find a theory section and a homework section.

At the end of the booklet there are several practice exam questions.

HYPERlinks

To make the book easier to navigate online, hyperlinks have been added to each page. You can click the mouse on the page numbers on the contents page to go directly to that page. This also works for the index page. To return to the contents page, simply click the page curl at the bottom side of the page.

There are also hyperlinks to websites which give additional information to a topic.

THEORY problem identification

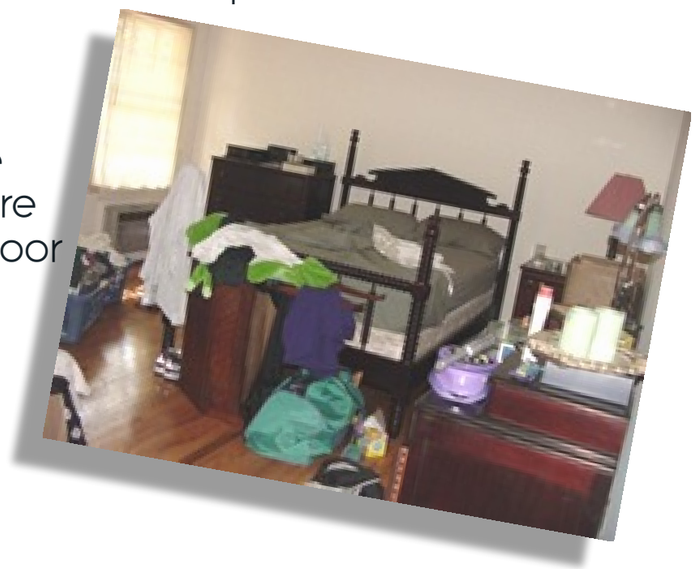
Problem identification is finding opportunities to create new designs. This means finding out what needs a person, or group of people, has, in order to design a product to fulfil that need. Once a problem has been identified, a brief can be created to allow a designer to solve the problem. Problem identification is finding opportunities to create new designs. This means finding out what needs a person, or group of people, has, in order to design a product to fulfil that need. Once a problem has been identified, a brief can be created to allow a designer to solve the problem

Methods of problem identification

Situation analysis identifies problems by looking at a scene and analysing ways that the situation could be improved. One way of doing this would be by taking a snapshot picture of a scene and using it to show problems. Describing in as much detail as possible the things that are happening in the snapshot breaks down the overall scene and suggests ways in which the whole situation could be improved.

Example of Situation Analysis

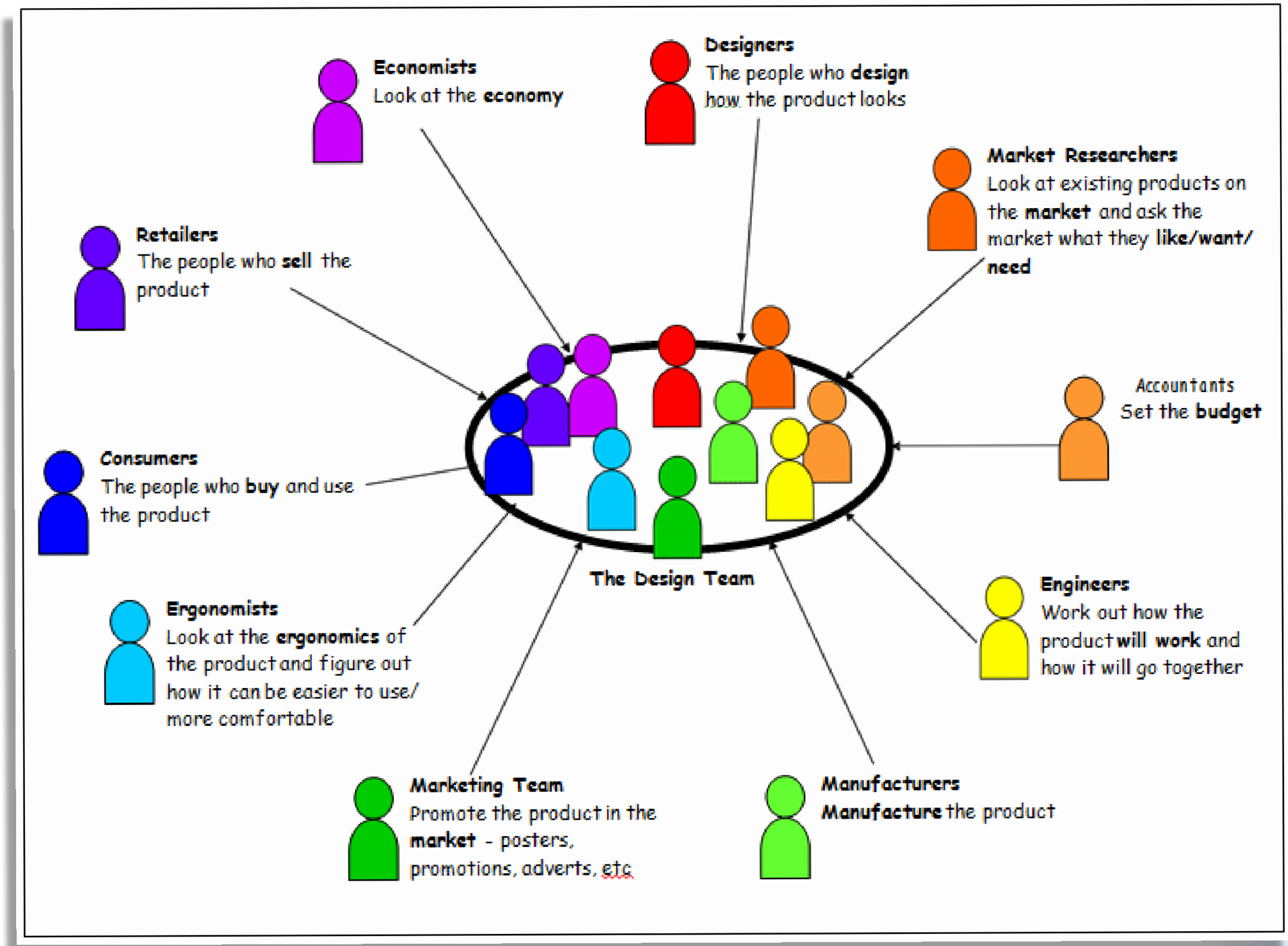
Situation–Messy bedroom.
Analysis–This untidy bedroom makes it difficult to find things or get to the bed. Clothes and grooming items are strewn across the room. Clothes are also piled near the heater which may be a fire hazard. There is limited floor space. There is nothing hanging on the wall. Possible Brief–Design a storage wall mounted system that would allow a variety of items to be stored neatly.



Product Evaluation

Product evaluation tests existing products and tries to find weaknesses in the product's design. All aspects of the product will be looked at including function and performance, durability, material choice, manufacturing and assembly methods, ergonomics, aesthetics, and economics.
Once a weakness has been found, a brief can be created to allow the designer to redesign and improve the product.

THEORY design team



THEORY design team

Ergonomist - Works with all aspects of ergonomics specific to the product being developed. Will give suggestions to the designer as well as facts relating to the human body and human behaviour

Manufacturer - Manufactures the components of the product and assembles the final product. Uses the plans and specifications given by the designer.

Engineer - Has knowledge and experience of engineering. There are different types of engineer that specialise in specific areas. Can advise the designer about this area with regard to what is possible for the product.

Consumer/client and user: - Person who will buy/use the product. Can aid the designer by offering opinions and feedback on the product at various stages of the design process. Consumer demand: the consumers have either a need or a want to which the designer will try to respond.

Retailer: Sells the product to the consumer. Can aid the designer by telling him/her what the public want and when they want it. Retailers can identify trends in sales and target markets, i.e. who is buying what and when. Retailers are the first people to know what is selling well and what is not.

Accountant: Budgets the project. Offers advice to the designer on the costing of the project, restrictions, etc.

Economist: Has knowledge of local, nationwide and worldwide economies and can offer advice on whether or not people are likely to buy the product. Taxes, house prices, petrol costs, etc., have a direct effect on people's lives and can control their standard of living.

Production specialist: Has strong knowledge of available processes and offers this to the designer during certain stages of the design process. Will try to find the most suitable method of production for a product by taking into consideration economics, environmental concerns, materials, availability, etc.

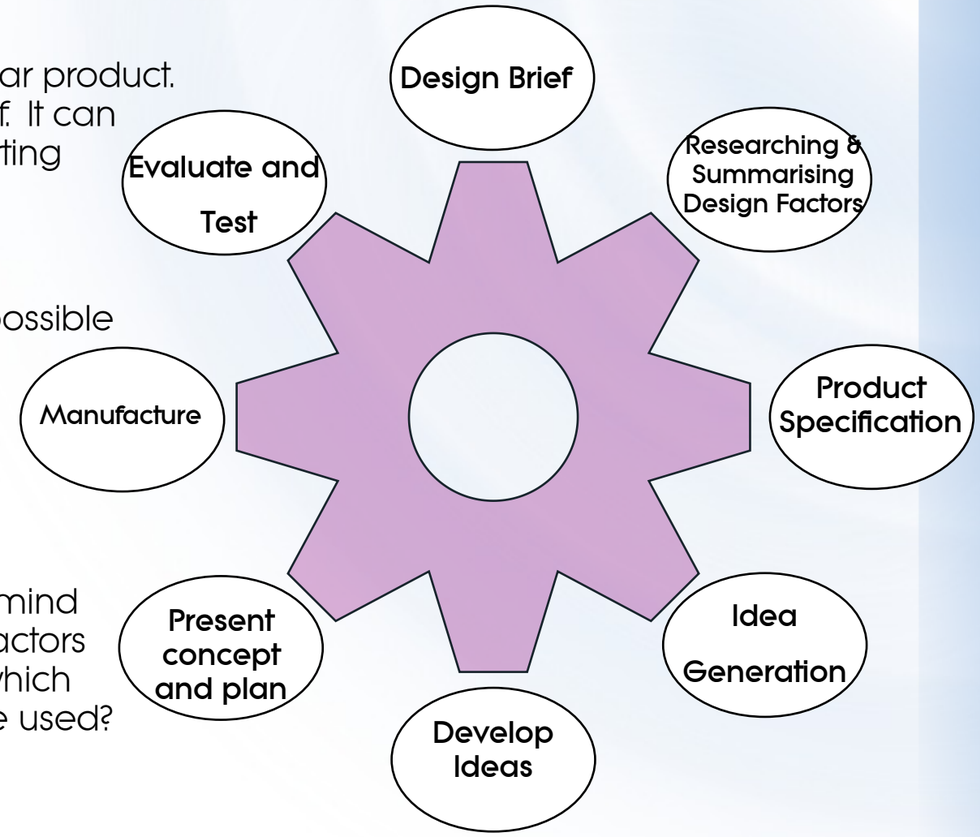
Marketing team: Carries out research on what the consumers' wants/needs are. Compiles findings and presents to the designer. Also is involved in the advertising and aids with sales of the product

Materials Technologist - Has knowledge of materials and their properties. Offers advice to the designer about the materials which would be best suited to the job, taking into consideration their properties, working characteristics, cost, availability, etc.

THEORY design process

Design Brief

The starting point in any design assignment is a need and/or want for a particular product. This need or want is generally put to a designer in the form of a problem or brief. It can be a short statement or a long detailed specification. The DESIGN BRIEF as a starting point basically states what has to be designed to solve the need or want.

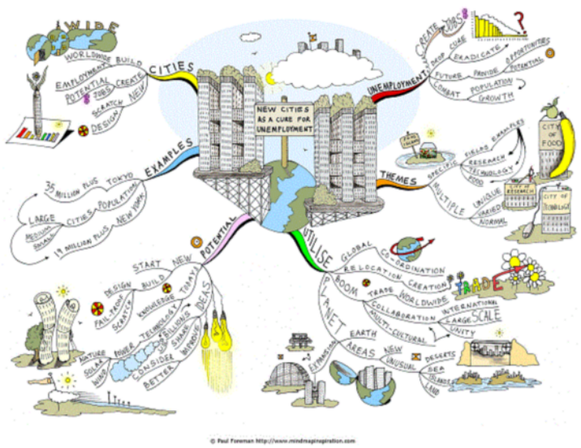


Researching and Summarising Design Factors

This is where you try to fully understand the DESIGN BRIEF by researching all the possible factors which may have an influence on potential solutions. This might include; looking through catalogues, talking to the client (the person who has came to you to design for their need or want) or looking at similar products in the market place.

Initial research

This stage of the design process is often started by tackling the problem using a mind Map (brainstorming). A mind map tries to tease out early thoughts about what factors will be required to resolve the problem. Some of the most important questions which will require to be asked are; Who will use it? Where will it be used? When will it be used? Why will it be used? What will it be used for? How will it be used?



Detailed Research

Having carried out the mind map to try to tease out the various pieces of information which influence in the design, the next stage is to carry out a more detailed investigation into the following **DESIGN FACTORS.**

- **FUNCTION & PERFORMANCE** – What exactly the product must do.
- **ENVIRONMENT** – Where the product will be used & stored.
- **ERGONOMICS** – How the product can be made to suit the users.
- **ANTHROPOMETRICS** – Ensuring the correct sizes are used to suit the users.
- **AESHETICS** – The image, appearance, colour & finish of the product.
- **MATERIALS & MANUFACTURE** – Properties of the material and build.
- **RESTRICTIONS** – Limits in time, cost, size, skill & performance.

THEORY design process

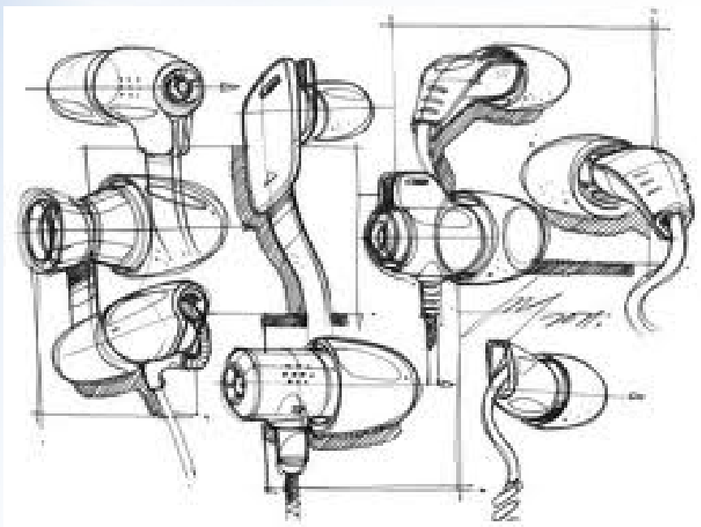
Market Research

As part of the detailed research it is very important to carry out MARKET RESEARCH, this is where we need to ask the people (the market) who are potentially going to buy the product being designed. This is very important because if we want them to buy the product being designed we need to ensure it is what they want (i.e. the most popular colour, texture, shape, etc). A typical SURVEY would ask thousands of people questions of this type to try to establish what the current trend in the market is (what they the buyers want). To carryout market research would involve using a pre-determined QUESTIONNAIRE which normally, would not be too long because if it was too long they would lose interest in it, therefore when making up such a questionnaire the types of question being asked must be kept to a minimum and be thoroughly thought out beforehand.

Product Specification

Having carried out the research to establish all the important facts which will have an influence in the final design of the product, the PRODUCT SPECIFICATION should be a listed summary of all these important facts. What the Product Specification is doing is SPECIFYING what the final product must have as part of its design. "It must", "it should" statements can be used here. i.e. a specific detail for the design of a chair could be as follows:-

- *It must be comfortable to sit on as the user will require to sit on it for long periods of time.*
- *It should have four legs for stability.*



Idea Generation

At this stage of the design process your actual ideas of potential solutions are SKETCHED down on paper. The quality of the sketch at this stage is not important, what is important is the quantity of different ideas. A habit to get into at this early stage is to ANNOTATE your sketches. What is meant by this, is, to write comments about all your ideas so as the reader can see what you are thinking] about for each of the sketches.

Develop Ideas

Here all your best ideas are examined in detail and improved with respect to improving the quality of the sketch, adding in sizes, exploding the views, etc. It could be that two or three ideas need to be combined to create the final solution.

THEORY design process

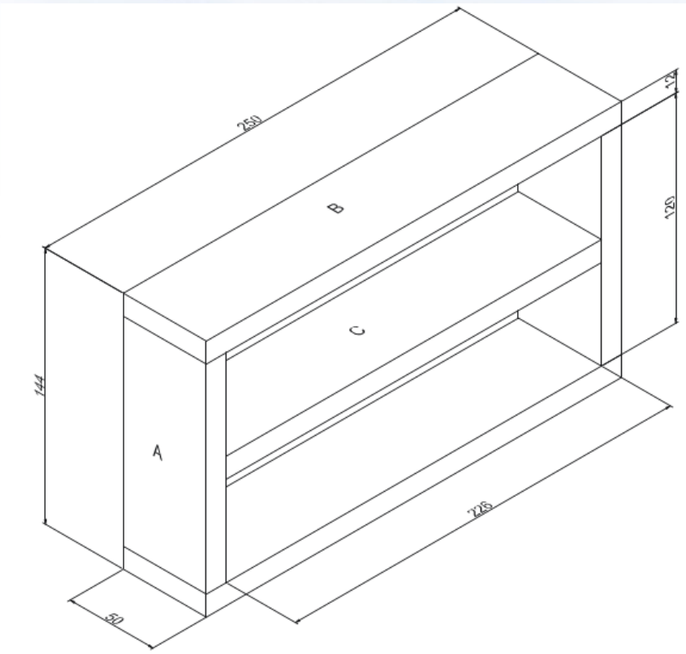
Present Concept & Planning

At this stage of the design process details such as sizes are added to allow the building of the design. Various types of suitable joints are investigated. The final concept will be presented as a fully rendered drawing. Review your existing PRODUCT SPECIFICATION and make amendments to it if necessary. Your final concept may have changed throughout the Design Process and no longer meets the Specification.

3D model

Where appropriate it is ideal to make a scaled down version of the proposed idea. The model could be made from various mediums such as card, modeling clay to miniature versions in wood. By doing this allows a greater insight in to how the product will look with respect to proportion. i.e. ensuring all the parts of the product look good and not out of place with each other.

The WORKING DRAWING shows all the various sizes of the design usually in orthographic format, i.e. three views of the object.



Cutting List (or Parts List)

This is a list of all the parts which will be required to assemble the product.

The drawing below is a finished 3D model of a product which was designed for a client. To enable the materials for that product to be made available, a cutting list has to be made. This is generally done in the form of a table as shown below.

Note:- If this product was to be manufactured and sold to the public it would be convenient for them to have it assembled (made up ready for use), but the reality is, the cost involved for the manufacturer would be far greater as it will take up much more space in the lorries.

If it was bought as a FLAT PACK (packed flat in a card board box) the manufacturer would be Able to deliver far more units at any one time thus cutting down on manufacturing costs, delivery costs and the amount of space required to store them. A drawing like the one below and an exploded view of the product will therefore be very helpful as it will allow the customer to see how it all fits together.

Material	Part	Quantity	Width	Thick	Length
Pine	A	2	50	12	120
Pine	B	2	50	12	250
Pine	C	1	50	12	226

THEORY design process

Presentation Drawing

The presentation drawing is a very important aspect of the design process, if the FINAL RENDERED DRAWING is carried out accurately and as real to life as possible, this can be presented to the client for his/her approval before the actual making of the product. It could be that the client is not entirely satisfied with the final product and therefore will be much easier to re-do a drawing than re-make the prototype model.

Sequence of Operations

Your sequence of operations page is really just a list of what you need to do in order to make your prototype. Having said that, however, writing a sequence of operations from start to finish can be difficult and should be broken down into smaller stages. The main stages in any sequence of operations should include the TOOLS, EQUIPMENT, MATERIALS, FIXINGS, TECHNIQUES and PROCESSES required to:

Prepare and mark out accurately
Cut, drill and shape
Assemble a sound prototype free from faults
Finish to a high standard

The sequence of operations should be broken down into instructions for the individual parts, i.e. the carcase, the doors, drawers etc.

THEORY design process

Evaluate & Test

This is the final stage of the design process and involves writing a report to summarise how well the product satisfied the BRIEF. This is done by comparing the final product to the PRODUCT SPECIFICATION.

Evaluate the MANUFACTURING PLAN and make suggestions and improvements. Could you make adjustments to make the plan more efficient? Evaluate the PROTOTYPE you have made. How could you improve the quality of the model? How could you improve the finish?

Evaluate the MANUFACTURE to allow your product to be made commercially. How could you cut costs? How could you save time? How could you mass-produce the product?

Some typical investigation questions used to help structure the evaluation report might include the following:-

- What tests were carried to ensure the product can do the job it was designed for, i.e. if it was a seat does it hold the weight of the person it was designed for?
- Did the product solve the problem?
- What do other people think of the final design?
- Does it look good?
- Does the final product meet the specific details listed in the PRODUCT SPECIFICATION?

In industry at this stage, the DESIGN PROCESS would start all over again making the adjustments you have recommended.

Think of the different generations of iPod and how the product improves each time it is evaluated and developed.

THEORY target market

The original meaning of the term "market" is a place where buyers and sellers gather to exchange goods. Today, most of the buying and selling of goods is done in shopping centres, high streets and, most recently, online. A "market" can be described as the set of potential buyers of a product or service. The size of the market will depend on the number of buyers of a particular product.

Interest

Consider a mountain bike as an example. We must think about how many people would be interested in buying a mountain bike. The potential market is the estimated number of people who show some level of interest in buying the mountain bike.

Income

Out of the number of potential buyers who have an interest in buying the mountain bike, not everyone will have the income, or enough money, to actually purchase it. The size of the market depends on both income and interest.

Access

The market can be reduced even further. For example, the company who manufactures, or makes, the mountain bike may not distribute to certain areas, or there may not be an outlet in those areas. This can often to be the case in remote areas, such as the Western Isles for example. The market then becomes the group of people who have an interest in buying a mountain bike, enough income to purchase it and access to buy it.

Market Segments

The market can be split into segments, like an orange, this just means into smaller chunks. These segments tend to be groups of people who are similar. We call this group of people the "demographic". The demographic for a product could be age, sex, income. Look at these examples below.

These trainers are aimed at girls
Demographic: sex

These trainers are aimed at children
Demographic: age

These trainers are aimed at people with money
Demographic: income

THEORY the marketing mix

The Marketing Mix–The 4 Ps

P Product
Anything that can be offered to the market to satisfy the need. Could possibly be part of an existing brand.

P Place
Where the product will be sold. This could be internet, mail catalogue, high streets, shopping centers, supermarkets, etc.

P Price
The amount of money the consumer pays for the product. This should reflect the image.

P Promotion
Any activity that will advertise the product. This could be adverts, in store promotions, posters, etc.

Glossary of Marketing Terms

Consumer Demands →	demands made by the market encourage products to be designed Social Expectations features the market would expect (e.g. environmentally friendly)
Niche Marketing →	targeting the product to a very small section of the market
Branding →	the image that the product reflects
New Products →	introduction of new products with improved features
Market Segments →	smaller groups with similar interests (e.g. sex, age, income)
Marketing Mix →	the 4 Ps; Product, Price, Place, Promotion
Needs →	important products or features that the market needs
Wants →	products or features that the market wants as a luxury
Technology Push →	advances in technology push the product development forward
Market Pull →	consumer demands pull the product into the market
Consumerism →	products become more affordable and accessible (e.g. Primark)
Impact of decisions →	as products become more disposable, how does this impact the environment?

THEORY accessfmm - annotating

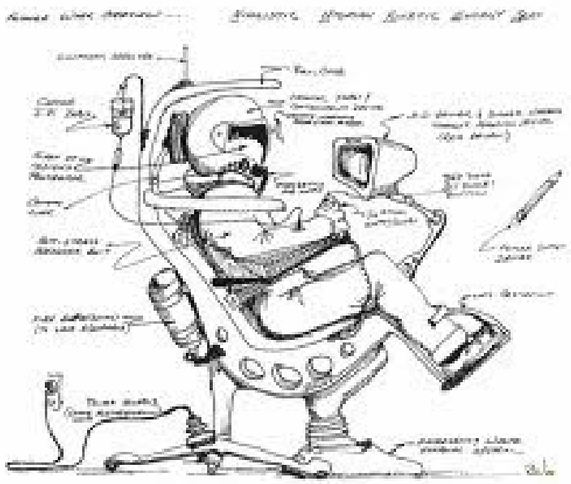
Explain about the product (good and bad points using the questions below to help) and why you think this is. e.g. the product is made from plastic as this is a strong, durable material available in a range of colours. Relate your observations to the product's customer/target market. e.g. the product is coloured red, blue, green & yellow this is because bright colours attract the attention of a young target market.

MATERIALS
- What is the product made from? Why?
- What do these materials need to be able to do? e.g. do they need to be waterproof/ fireproof/easy to clean/lightweight/flexible/ strong etc?
- Would a different material work better?

AESTHETICS
- What does the product look like?
- Why does it look like this? Consider colour, shape, texture, theme, graphics, fonts etc.

CUSTOMER
- Who is the product designed for? How and where would they use this product?
- How does the product attract the attention of the customer?

MANUFACTURE
- How was the product made? e.g. one-off, batch, mass, subassembly production?
- How has the scale of production affected the choice of material and production process?



COST
- How much does the product cost to buy?
- How much does the product cost to make? Why this much?
- Is the product good value for money?

FUNCTION
- What is the product's purpose/job? Does the product do this?
- How easy is the product to use?

ENVIRONMENT
- How easy it is to recycle the materials the product is made from?
- Are the materials sustainable? From a renewable or nonrenewable source?
- How does the product affect it's surroundings? e.g. radiation from mobile phone.

SAFETY
- Does the product have any risks? How can these risks be eliminated?
- Does the product meet safety standards?

SIZE
- Why is the product this size?
- Does the product work best at this size? What would happen if the product's size was increased or decreased?
- Has the designer considered ergonomics?

THEORY design factors

Design Factors - Function

Function What does the product do? Does it only do one thing, or does it do many things? Normally products have one main function, this is called the Primary Function. Along with the main function, the product may also have many other functions that are less important, these are called Secondary Functions.

Primary function of this product is having a space to do work of some sorts as it is a desk.

Secondary functions are Storage (it has drawers) and to be nice to look at (it is not your average flat pack desk

Design Factors - Environment

Environment Many people (potential customers) are concerned about the environment and the damage caused to it by industrial production. When designing a product it may be wise to ensure that the materials can be recycled or the product itself can be manufactured from a large proportion of recycled materials.

Along with looking into recycled materials many people like to know if The products were "Greenly" produced and manufactured. So were the products made individually by hand with a small Carbon Footprint, or were they mass produced in a big factory that uses up lots of electricity and have a big Carbon Footprint?

Location

(can also come under the Environment heading).
Where will the product be used (inside, outside, what room)? Where will the product be stored when not in use (space/size)? If you were looking at a product that was going to be used mainly in the bathroom then you would have to think about the environment of a bathroom.... It is a wet and warm environment as this is where people shower and take baths, meaning that condensation will build up on the things in the room. The product would therefore need to be waterproof and easily cleaned. The product would have to be made of a material that would not rot or rust..... etc.....

THEORY design factors

Design Factors - Economics and Performance

Economics is when we are thinking about how much everything is going to cost... What is the cost of the materials and labour required to manufacture the product? How do you know if the price you make the product is going to cover all of your outgoing cost? Most products are much cheaper to buy today than in the past. This is mainly due to the economies of mass production. The more a process produces, the cheaper each item becomes. The use of modern materials, e.g. plastics, means that complex items can be produced by a single process like injection molding.

The price of a product depends on creating a balance between:
➢Manufacturing costs. How much it costs to make the product, including materials & labor.
➢Advertising and distribution costs. If potential customers don't know that you have a new product then no-one will buy it, Advertising the product in magazines/tv/radio costs money. The product also needs to get to the shops from the factory and hiring lorries costs money.
➢Prices set by other manufacturers. If the product is too expensive compared to similar products that are already on the market customers probably won't buy it, if it is too cheap then customers might think that it's no good and not buy it either... the price of the product has to be similar to other similar products but still competitive.

Performance - When talking about the performance of a product it is important to consider things like Durability, Ease of Maintenance, Running Costs, and more importantly is the product value for money? To determine whether a product is good value for money you must consider several things: Is it worth the price it is sold at? Consider its quality, how well it performs its intended purpose, as well as other design factors such as its aesthetic and ergonomic qualities. What are the running costs of the product after the initial purchase cost? Is the product Durable or will it break easily after a few uses? Will it cost anything to maintain? If it breaks will it be cheaper to fix it or get a new one?

Durability
Durability is the life expectancy of a product, or how long it is expected to last. This is decided by the materials that the product is made from and Planned obsolescence.

Eg 1. A car exhaust is normally made from mild steel which will eventually rust and need replaced after several years. But the exhaust could be manufactured in Stainless steel which will last a great deal longer, but will be more expensive to purchase and will mean that the manufacturers will not sell as may spares.
Eg 2 Traditional Light bulbs are expected to last no more than six months in normal use. But new low energy light bulbs which are more expensive can last for years.
Eg 3 Washing machines are designed to be replaced after about six years, this allows the manufacturer to constantly sell new models, bringing in more business by continuing to satisfy the buyer's desire to have the latest, most fashionable model.

THEORY design factors

Design Factors - Market Niche

Where in the market are you aiming to sell your product?

- Bottom end – Cheap but functional for a reasonable lifespan.
- Top end – Expensive, best of everything, long lasting.

Planned Obsolescence

In many instances it is possible to design a product that will last a lifetime but is this necessary or indeed desirable?
If a manufacturer of washing machines produces a machine that will last forever, what impact will this have on the manufacturer's business?

- The manufacturer will not sell as many machines.
- The machines will be very expensive.
- The buyer will end up with a product that still works well, but is old fashioned in style and uses older technology.
- Think of computers - who wants last year's model?

Designers and manufacturers have to find a balance between profit, value for money, durability and satisfying the buyers' desire to own the latest, most fashionable products.

So they build in obsolescence and this allows the manufacturer to constantly sell new models, bringing in more business by continuing to satisfy the buyer's desire to have the latest, most ashionable model.

In reality, most products have a built-in life expectancy.

- Light bulbs are expected to last no more than six months in normal use.
- Washing machines are designed to be replaced after about six years.

THEORY design factors

Ease of maintenance
Ease of Maintenance is how difficult it is for a user to keep a product in good working order throughout its life. A cheaper product is probably intended to be thrown away after use and will need no maintenance. A more expensive product is likely to last much longer and will require periodic maintenance to keep it in good order. The complexity of a product will have a direct effect on the amount of maintenance required. A very complex product like a car will require a great deal of maintenance in its lifetime, from the regular servicing of the engine to ensure oil and water levels are correct to the replacement of worn parts like brake disks to prolong the life of the car.

These disposable toothbrushes are designed to be thrown away once the heads are worn out. There is no design for ease of maintenance required and their price is fairly low.

The oral-B electric toothbrush is designed to have a replaceable head, so that a consumer does not have to buy a whole new toothbrush each time the head wears out. This increases the initial cost of the product as There are additional components required to enable the head to join to the body, but allows the main body of the toothbrush to be used for a long time. Consumers would not buy the Oral-B at all if they needed to replace the whole product as often as they replace a fixed head.

Materials
When coming up with a design for a product we must consider how many are to be produced, who the target market is, what the product is going to be used for, how and where it is to be used. When we have established all of this it becomes easier to decide which materials would be most suitable for the job.
In order to decide which materials to use we must have an idea of what properties we wish them to have. For instance, a car wing-mirror must be waterproof, resistant to sunlight, impact resistant, chemically resistant and corrosion resistant. On top of this, the shape of the wing mirror must be able to be formed easily as it is a 'mass produced' product.

Choice of Materials will have a direct effect on several aspects of the design, including:
The manufacturing processes that can be used, The finishes that can be applied, The disposal of a product at the end of its life, The cost of the product, The lifespan of the product, The product's performance in terms of strength, weight etc. Cutlery made from stainless steel will be long lasting, corrosion resistant, expensive and will require costly die cast moulds to produce. Cutlery made from HIPS will be cheap, light, easily broken, recyclable, will come in a range of colours, and will require injection moulding machinery to produce.

THEORY design factors

Design Factors - Aesthetics

This is about how good a product will look. A well designed product will look attractive and possibly have a distinctive style of its own, if a product was designed and its function was extremely good but it did not look good, how many people do you think would buy it? It is sad to say but very few people would buy something that did not look good. The look of the product is very important. What makes a product look good? Factors which would be used in evaluating how good a product looks would be as follows:

- The shape, size and proportion of the product.
- The colours, materials and textures.
- Does it have a distinctive style of its own?
- What sort of image does it project? Is it aimed at young people or the older generation?

Aesthetics is an important consideration for the designer because it concerns the way Things look. Consumers are more likely to buy products based on their appearance. The following are the main considerations that a designer would make when considering aesthetics.

Colour and Shape

- The two aesthetic properties that are easiest to understand.
- Both colour and shape can be used to create contrast or harmony.
- Colour can be used to target specific markets i.e. bright colours would be used for children's toys, sophisticated colouring for high class products and so on.

Harmony

- This is where parts of a design work well together or the design fits in with a specific environment
- It creates a sense of peace of relaxation.
- Simples shapes and colours that work well together should be used to achieve this.

Balance

- Most products are designed to be symmetrical. Others can be designed asymmetrically.
- Experimenting with different shapes or colours can add interest to your design.

Pattern

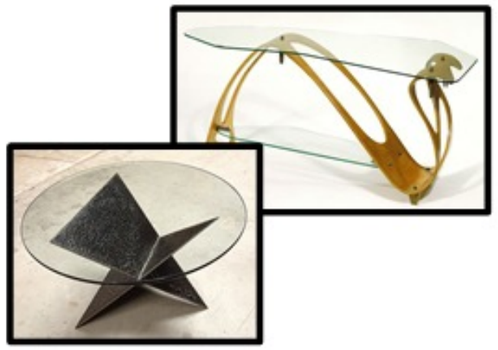
- Repeating a design feature to create a pattern can create a unified and organised looking design.

THEORY design factors

Texture
- Different textures can makes designs look more stylish or interesting. Effects such as glass, concrete, wood grain, hard, soft, glossy (shine), matt (flat dull colour) and so on.

Contrast
- The opposite of harmony where designs are made to stand out and be bold.
- This can sometimes make a design more eye-catching.
- Contrasting colours (purple/yellow) and a mixture of shapes can make designs bold and contrasting.

Proportion
- Small changes to the proportion of a shape can make it look more elegant, classy, stable or sleek.
- This example of a 1980's BMW 3 series and a modern 2007 BMW 3 series shows how simple changes to shape can make designs more modern, sleek and elegant.

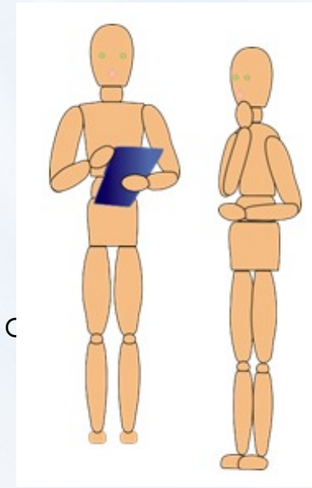


Form
- This regards that shape of a design. Will it be geometric (Squares, triangles, circles and so on) or will it be organic (free flowing curves, natural designs).
- Form is also 3D and is developed from initial 2D shapes.

Line
- Using lines in a design can make it formal and informal.
- Lines normally cause a contrast and can add a lot of interest to your design.

THEORY design factors

Design Factors - Ergonomics

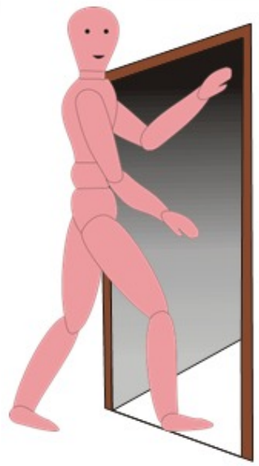


What is this ergonomics? As far as we are concerned, it is about designing products to suit a particular need and/or want. This statement means that, we design products to "FIT" the user whether that user is six months old or an adult. The two figure opposite are ERGONOMES (scale models of humans that can be posed in various ways).

You and the product – How well do you work together?
Ergonomics (or the human/product interface) is about making your life simpler, safer or easier, by taking account o dimensions of relevant human body parts when we design things.

Taking the example of the **ergonome** sitting in the car seat, the seat has been specifically designed to fit our body shape with respect length of leg, back support, the headrest and the position of the steering wheel. As you sit reading this booklet, take any object around you and think about it. Why has it been designed the way it has? A pencil is the shape it is, because it fits neatly between our fingers. An aerosol can is of a diameter to allow easy handling, the nozzle is shaped to make it easy for a finger to disperse the contents.

Looking at each of these items do you think they have been designed with short or tall people in mind. The answer to that question is neither. The vast
majority of designing is done for the average sized person. This is because the people who design and make products want to sell as many as possible and therefore designing for the majority will result in more product sales.



It has just been stated that ergonomics is about designing things to suit our needs and that we design for the "average person", this is true for the majority of cases but there are the exceptions.

One of the most obvious every day objects in use, is a doorway. If the doorway was designed for the average person anybody above the average height would hit their head off the top of the door frame. The height of a door frame is designed to suit the taller people in our society. As for the handle of the door, if this was placed at a height which was suited to a person of average height the smaller people may find the handle difficult to operate.

THEORY design factors

Design Factors - Safety

Why is safety important?

Unsafe products have the potential to cause harm through injury and legislation forbids or restricts their sale. All products are required by law, to meet safety standards, and cannot be sold if they do not meet those standards.
Products will often display symbols to show compliance with safety legislation. If, after being sold, a product is found to be unsafe, the product would be recalled and some form of compensation made to the consumer. Recalling a product is very expensive for a company to do.

Safety is also seen as a major selling point for many products. For example, cars are often advertised by highlighting their safety features. A consumer is more likely to buy a product which has additional safety features.
Many products are created to fulfil a specific safety need. For example child seats for cars, or bicycle helmets are created to protect the user in the case of an accident. Designing safety products is an example of niche marketing.

How do I know if a product is safe?

All products sold must pass safety standards, and many will have symbols on them which show the consumer that they have been approved by the relevant organisation.
These symbols are often found on a sticker or moulded onto a product, or printed in the product's instructions.

British Standards Institute (BSI)

The BSI set and check standards for all products sold in Britain. Products which meet the standards are awarded the BSI Kitemark.

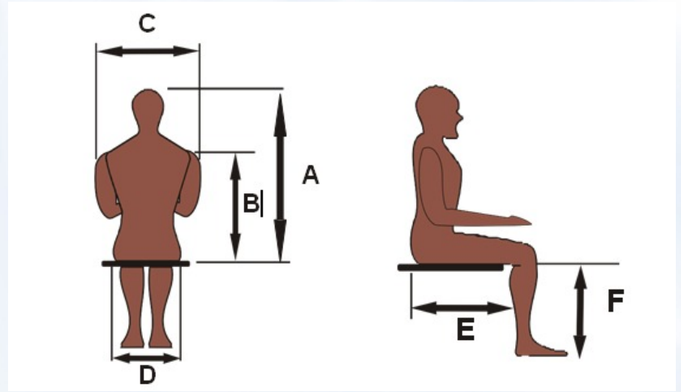
European Community

The CE symbol indicates that the product has met European regulations and can be sold across Europe.

THEORY anthropometrics

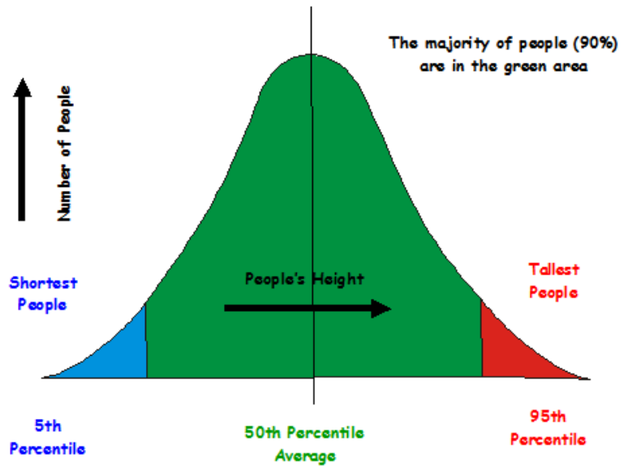
Anthro – what/ - Anthro·pom·etry.

So far we have discussed designing things to suit our needs i.e. ensuring anything which we design will fit us. Anthropometrics is about the sizes of individual body parts. If the design brief we were given was to design a chair, the sizes which would require to be taken would be as shown in the sketch below. E, F & D.



Although it has been stated that these sizes will be taken, it is not quite as simple as that. Remember that it is the average size of person that we require to design for. We all come in various shapes and sizes, therefore a large sample of people will require to be measured to establish the average sizes.

Regardless of where in the world we took the sample, the results would produce a graph very similar to the one shown below. What the middle of the graph is telling us, is, the majority of peoples height is quite similar. The graph above has taken peoples heights as its sample. Assuming the combined average height of adult men and women is 1.65m. This AVERAGE HEIGHT we call the 50^{th} Percentile (50^{th} %ile).



As designers, this would represent the majority of potential consumers and therefore there would be more likelihood of them buying the product. The graph also shows 0 - 5^{th} %ile and a 95 – 100^{th} % ile.

The 0 - 5^{th} %ile represents the minority of people who are VERY SHORT.
The 95 - 100^{th} %ile represents the minority of people who are EXCEPTIONALLY TALL.

Designers generally regard anybody who is below the 5^{th} %ile or above the 95^{th} %ile as being either too short or too tall, and are therefore not taken consideration of when designing the majority of products.

Now that we have considered that we have to take the average size of a persons body parts, we are now going to consider what sizes are required to design a mobile telephone. Some of the factors which will require to be considered are the finger size, finger

THEORY technology push/market pull

Any product can be categorised into a ***technology push*** or a ***market pull***.
Technology Push = (NEW TECHNOLOGY) technological and scientific developments that are used by design teams to produce new products. You might not know you wanted one before.
EXAMPLE: Apple Ipad

Market Pull = (NEEDS OF SOCIETY) inspiration for new products often comes from the needs of society. The needs of society and the demands of a product are changing all the time meaning research and development teams often modify existing products for changed markets. These are often updates to existing ideas.
EXAMPLE: Programmable washing machine

Product 1 – First Mobile Phone

Product 2 – Apple Iphone

Product 3 - BAGGED Vacuum

Product 4 – Dyson (BAGLESS) Vacuum

Product 5 - Sony Walkman

Product 6 - Apple Ipod Nano

Product 7 - Ford Capri

Product 8 - Ford Focus Electric Car

THEORY technological opportunity

Technological opportunity

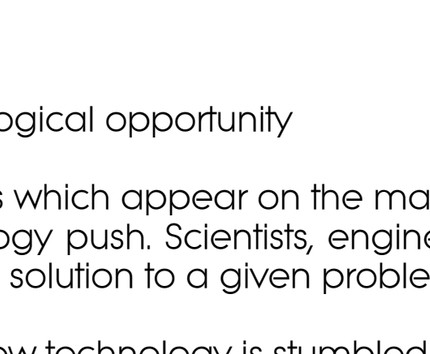
Products which appear on the market, sometimes do so as a result of technological innovation. As we saw, this is often referred to as technology push. Scientists, engineers and designers are always looking for new ways of doing things and always striving for the ultimate solution to a given problem.

Often new technology is stumbled upon in this search. Sometimes the new technology has an immediately obvious application and sometimes not. Sometimes technology is transferred from one application to another.

In other words sometimes new technologies create new products and therefore a completely new market niche appears.

Examples of products from new technology:

Microwave oven - from research into wave energy-

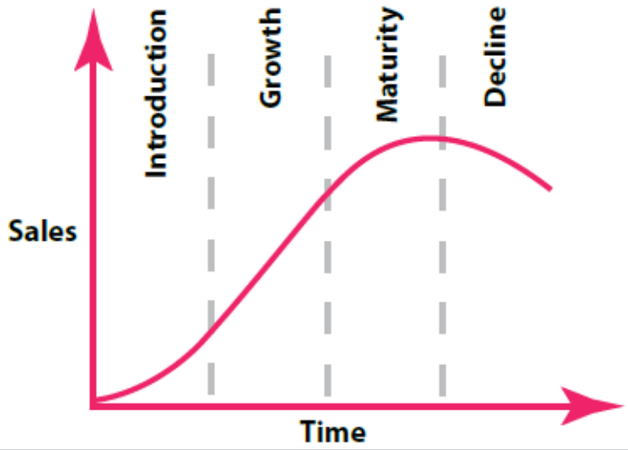


Sony Walkman - through advances in microelectronics

Ceramic knives - from space-shuttle research.-

THEORY product life cycle

The four main stages of the product life cycle are:
1. Introduction - A product is introduced into the market for the first time.
2. Growth – The product is beginning to be recognised and is becoming more popular
3. Maturity – The product has peaked in terms of costs, profits and sales.
4. Decline – The product is beginning to die out more innovative products are starting to replace it. These stages are illustrated in the diagram -



1. Introduction
- Marketing costs are extremely high as consumer product awareness needs to be created
- Sales are slow
- There are few to no competitors in the market
- Demand for the product has to be created
- Customers have to be encouraged to try the product
- There is very little profit at this stage
- Skimming and Penetration pricing may be used during this stage

2. Growth
- Costs are reduced due to economies of scale (The average cost of a product decreases as output and sales rise.) Larger quantities of the product are produced.
- Product sales increases significantly
- Marketing costs will be lower than in the introduction phase as awareness to the product has been created.
- Product begins to make more profit
- Consumer awareness of the product increases
- Competition increases with new companies entering the market

New competition leads to potential price decreases. Competitive pricing is used.

3. Maturity
- Production volumes increase and in effect costs are lowered
- Product sales peak and market saturation is reached
- More competitors enter the market
- Prices drop due to a boost in competitors products in the market
- Persuasive advertising takes place differentiation of brand and diversification of features are emphasized to increase or maintain market share.
- Marketing costs are lower than previous 2 stages. Sales promotion techniques are used e.g.: BOGOF
- Industrial profits decrease

4. Decline
- Costs become counter-optimal
- No marketing activity would take place during this phase as product is in decline.
- Sales start to decrease
- Profit margin diminishes
- Any profits are made through distribution and production efficiencies rather than increased sales
- Remaining stock sold off

THEORY product life cycle

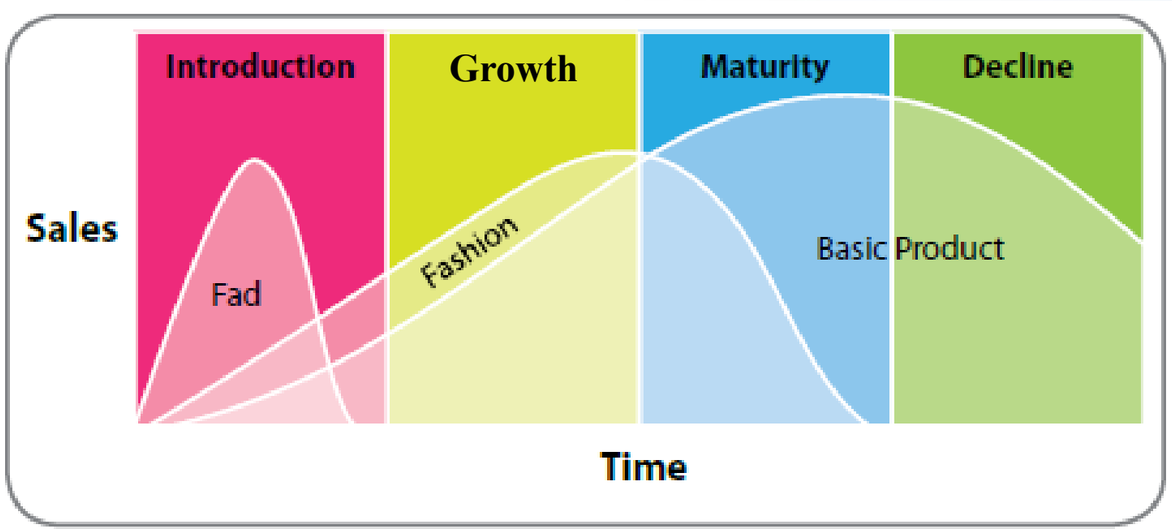
All products have a finite life and their progress from beginning to end can be illustrated by using what is referred to as the 'Product Life Cycle Curve'. The product life-cycle illustrates the life of a product in a market with respect to sales, profits and costs. Sales of a product pass through each of the distinct stages of the products lifecycle. Products have different life expectancies and as a result can generally be split into 3 types of products known as Basic, Fashion and Fad.

Fashion products usually last for a shorter period of time than a basic product. Products within this group have a short lifecycle; the length of this cycle follows the latest fashion trend and popular styles. When fashion products have reached maturity their decline is normally quite rapid. Examples of products within this group are: Clothes, House décor etc. The fashion cycle will generally repeat itself every couple of years.

Basic products offer the longest product life-cycle. Products within this group have a stable and long life-cycle because there is a substantial need for the product in the market. These products will not generally decline unless there is a major product innovation to replace the need for the product. Examples of products within this market are: Cars, Refrigerators, Cookers, and Houses etc. The number of basic products sold are the highest of the 3 types of products (basic, fashion, fad).

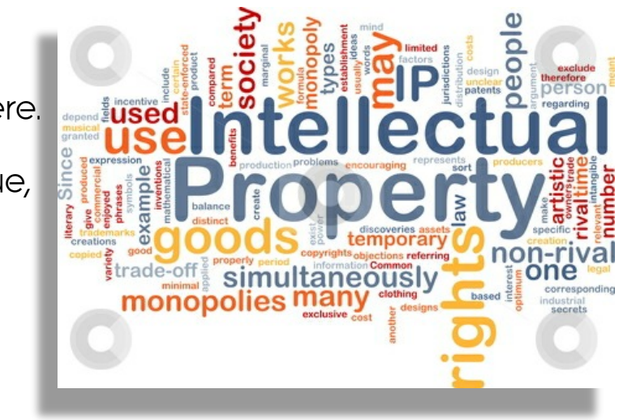
Fad products offer the shortest life-cycle, this life-cycle will experience rapid growth followed by a very steep decline in sales. Fad products are normally adopted by groups of young people. Examples of products within this group Are: Furbies, Clackers, Tamagotchi, Roller Disco's, Foam Parties etc.

A products life-cycle is always illustrated by a graph, the shape of a products life-cycle will therefore differ depending on the type of product. The diagram illustrates the curved nature of these three types of products life-cycles.



THEORY intellectual property

What is intellectual property?

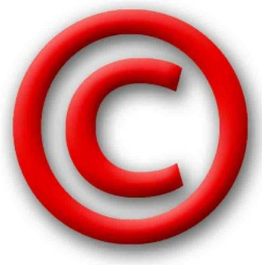


Creative processes generate new ideas, whether in the field of product design, music, art or elsewhere. These ideas, which may have commercial value, are the intellectual property (IP) of the creator, whether they are an individual or a company organisation. IP can have enormous commercial value, and can be traded as a commodity. However, Commercially valuable ideas can be at risk if not carefully protected, and others may gain commercial advantage as a result. Over the last three hundred years five different types of IP protection have been developed on top of the first type ever used:

Confidentiality. Copyright. Trademark. Design right. Registered design. Patent.

Why is intellectual property important? IP is important because it brings benefits to those who know how to take advantage of it. The two main ways to do this are: Ideas can be protected from exploitation by other parties. Much research work becomes public and is thus a valuable resource

Confidentiality
Only three people in the world know the exact recipe for Barr's Irn Bru. Until recently they were all members of the Barr family, but now one of the company employees has the 'know how'. The reason that the recipe is kept secret is that competitors have to guess how to copy it, whereas if it was patented they could visit the patent library, find out exactly how it is made and alter their own brew slightly, and not to infringe the Barr patent. Some agreements prohibit those 'in the know' from travelling together in the case the secret is lost due to an accident. A confidentiality agreement is usually drawn up by a solicitor and is signed by those 'in the know'.
This is then legally binding and any breach could result in legal action.



Copyright
Copyright is used mainly to protect written, printed or broadcast materials, and is relatively simple to use. It actually exists on any written piece, the copyright usually belonging to the author automatically, although it can belong to the company employing the author if that has been agreed. Look at the bottom of this page to see who owns the copyright in this PowerPoint presentation. The copyright can be bought and sold in the same way as any other commodity.

Example
The most obvious examples of copyright are books and other printed materials, where the copyright usually belongs to the author, or the publisher. Films, TV programmes, songs and music are nearly all protected by copyright. Pop groups often copy other groups' songs; this is called making a cover version. The second band to record the song have to pay royalties to the writer of the song and therefore do not make as much money. The simplest method to ensure that the copyright is known to belong to the author is to mark the item with the © mark, and then proving it was produced on or before that date. A formal method is to send a copy to a lawyer or bank for safekeeping. A copyright registry exists for music, and this charges a fee.

THEORY intellectual property

Trademark

Trademarks are all around us nowadays; indeed you may be displaying some on your clothing as you read this. Most logos that you see on anything from adverts to clothing are Trademarks. They identify the product with a company, and the company hopes that its image will help to sell the product. Trademarks have been registered since 1876, at the Patent Office.

Trademarks are usually words, although it is becoming more common for other items to be protected in this way too, for example tunes (T-mobile) and aromas (perfumes, etc.). Companies protect their names to prevent other Competitors from copying or 'passing off' their products. It is common practice not to trademark the company's own name, but only the 'brands' that they produce. Some companies may wish to protect their company logo and in some cases this can be done, for example Nike.

Example

There are thousands of different trademarks in existence at present, and many more whose protection has expired. Trademarks have become a fashion accessory, particularly in the clothing industry, where clothing manufacturers use their trademarks to create very strong brand images, which the public find desirable and stylish.

Trademarks are applied in groups, each group representing a different range of products. For example, the name Mazda is trademarked by three different companies: the car manufacturer, the light-bulb manufacturer and the cooking-oil manufacturer. The reason this can be done is that each company operates in a different sector and thus will not be competing in the others' markets. There are different trademark sectors, and as it costs money to register for each sector, most companies only register in the sector that directly affects their business.

Process

Companies do not have to trademark their names, but it can be very worthwhile to do so. Even if a name is not registered, after some time it will begin to be associated with the product and rights will be established: these names have ™ beside them. However, registering the trademark is much more clear cut and has distinct advantages. Trademarks are best applied for early in a product's life to prevent problems. When a company applies to the Patent Office for a trademark a search is carried out to find whether other companies are using the same or similar names. Companies can have the same name however if the other company falls into a different sector.

If a trademark is granted it can last forever, or as long as the company keeps paying the renewal fees every 7 years, and the letters RTM or the symbol ® can be used beside the name. The first ever trademark registered was by Bass, the brewers, and it is still registered.

THEORY intellectual property

Design Right

Design Right is a new form of IP that was introduced in the UK in 1988 and which is very similar to Copyright, although there are some important differences. Design Right's main similarity to Copyright is that it exists automatically, i.e. there is no application process involved. However this in turn means that it offers less protection, and is really only suitable for protecting items that fall out with the other forms of IP protection. Due to its simple nature it is also a cheap form of protection.

Examples

Design Right is particularly useful for protecting the way things look; shape, form and appearances of products that are different from before but sufficiently so to allow for patenting. For example, the appearance of a new toaster may be protected by Design Right because underneath the stylish case are the same mechanisms as the previous model's. As there is no formal registration system for Design Right, all that needs to be done is to mark the work 'Design Right' and date it. However, it is a good idea to keep the idea secret until this has been done and an original has been kept somewhere secure with proof of the date when it was done. Design Right only protects the idea in that specific form, and it is easy for competitors to copy with minor changes so as to avoid infringement of the Design Right. DR has a short lifespan of only 10 years from the first sales, and during the last 5 of these anyone is entitled to copy the design provided they pay a licence fee to the owner of the IP.

Registered design

Registered Design is a form of IP protection that was first used in 1787, in response to the demands of the textile manufacturers who were concerned about competitors using their patterns. It is still much used by industry today as this form of protection covers the appearance of a product, but not how it works. If the way it works is new then a Patent may be applied for, in addition to using Registered Design to protect its appearance. It is important to understand that one product may involve several or even all of the forms of IP protection.

Examples

Car body shapes are good examples of Registered Designs. Manufacturers want to stop other companies copying successfully styled cars, even if the technology inside the car is too similar to the previous models to be able to patent them. Distinctive features such as radiator grills can be protected as well as the overall body shape.

Process

The process for registering a design is similar to that for obtaining a patent and is also controlled by the Patent Office. The design has to be kept confidential before the application is filed, and then a search is carried out to see if there is any previous work that is similar. If the search does not show up any possible conflicts, the design is granted its Registration. Once granted, the registration can be kept for 25 years, as long as renewal fees are paid. If the company does not feel it is worth spending the money as the product's life cycle nears its end, they may allow its registration to lapse. This enables competitors to begin copying the design legally.

THEORY intellectual property

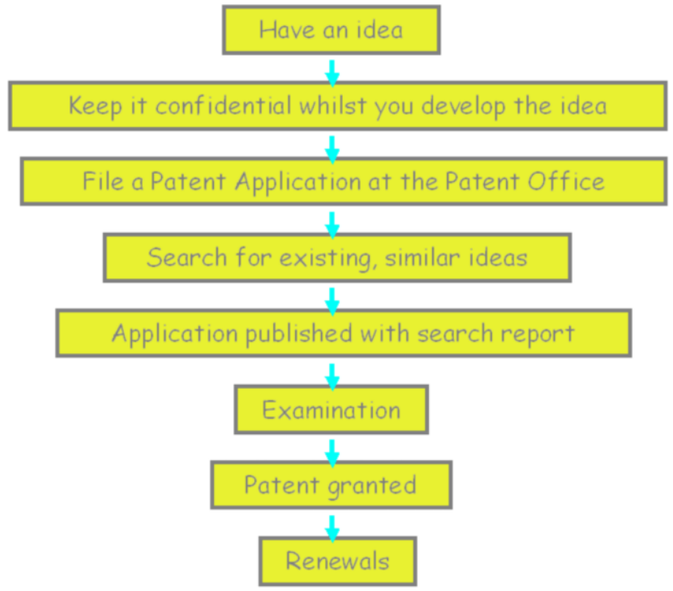
Patent

The first patent was granted in 1449, to John Utynam, who wanted to protect his method for making stained glass. He was granted a monopoly on the process for 20 years by the King, in the form of an open letter. This was the method before the Patent Office was opened in London in 1852. Nowadays, over 30,000 patents are applied for each year. If you own the patent on a product you will have exclusive design rights on it for up to 20 years. However, as part of the process the patent is made available to the public for any interested parties, including competitors, to see. This has two results: firstly, competitors can keep an eye on what the opposition are working on and see which way the market may be going; and secondly, 65% of research and development (R&D) has been done before and is available for viewing in the Patents Library. This can save vast sums of money in R&D budgets. The main aim of this process is to encourage innovation.

Examples

Tracks: Tanks and diggers are fitted with tracks which enable them to travel over soft ground without them sinking and becoming stuck. The first use of tanks was at the Battle of Cambrai in 1916, during WW1, and most people think that this was the first time that tracks had been used. In fact the first patent for such devices was issued in 1770! A famous example of a successful patent is the Anglepoise lamp. This was developed in the 1930s, and is still used worldwide today.

The flowchart below shows the main stages in obtaining a patent.



Patents do not have to be maintained for 20 years. They can be allowed to lapse by not paying renewal fees annually after the 4th year. If the patent lapses your competitors may start using your

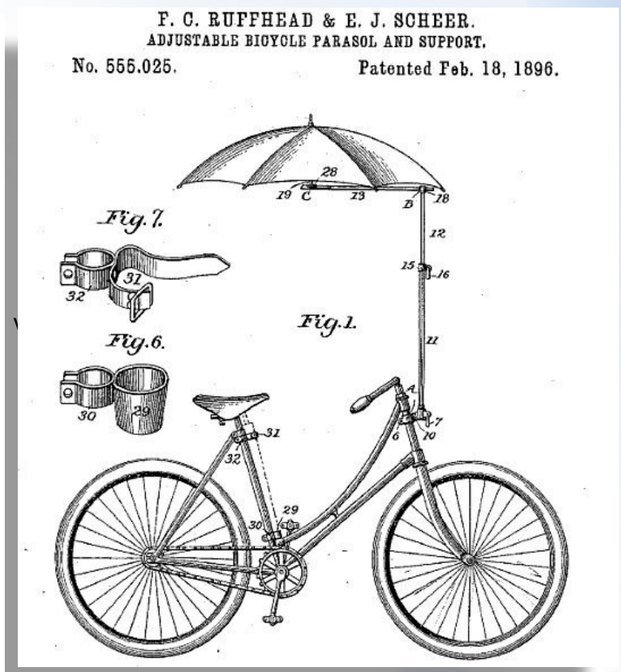

F. C. RUFFHEAD & E. J. SCHEER.
ADJUSTABLE BICYCLE PARASOL AND SUPPORT.
No. 555,025. Patented Feb. 18, 1896.

Fig. 7.

Fig. 6.

Fig. 1.

THEORY types of production

Mass Production
Mass production involves the product going through many stages of a production line. There are workers and machines at certain stages along the line that are responsible for making certain parts of the product. This means the product is often made over days or even weeks depending how complicated it is. This product is often quite reasonably priced due to the large scale production techniques used. However if a problem occurs it will stop the whole line of production. A classic product could be a car.

www.tes.co.uk/teaching-resource/Mass-production-of-chocolate-

Batch Production
This is when a series of products which are all identical are made jointly in either large or small numbers. 2 – 100 is usually classed as batch. Once these have products have been made once more of the same products may be made using the same equipment. This equipment includes tools, moulds, machinery and labour. A classic product could be a chair, newspapers, books, electrical products, etc.

www.bbc.co.uk/learningzone/clips/production-on-mechanised-production-lines/8487.html

One off production
This is when only one product is made at a particular time. This one off product could be a prototype a one off object or a hand made object. Prototypes are made to see if a product works before it goes into large scale production. One off production takes a long time and often means it is expensive. A classic product could be a mobile phone prototype, a one off specialist product, handmade items, etc

THEORY types of production

Continuous production

This is where a product is continuously produced over a period of hours, days, weeks or even years. This kind of production means the product will often be quite reasonably priced. A classic product could be screws, bricks, food products, etc

http://www.youtube.com/watch?v=prHyUoKu3MI

Just in Time production

JIT is when a factory orders in and uses only the materials they need, when they need them. Stock is kept to a minimum with products being only produced when the demand is there for them, warehouse costs are therefore reduced. Bulk deals and reliance upon materials and deliveries.

Advantages
Reduced stock and therefore reduced warehouse and storage space needed – cheaper overheads. Less finance is tied up in stock as every product is already ordered by a customer and the suppliers provide materials and components when needed.

Disadvantages
Reliance on external suppliers.
Reliance on materials.
No available off the shelf stock.

http://www.bbc.co.uk/learningzone/clips/just-in-time-practice/368.html

THEORY modelling

What is modelling in Design and Manufacture?

Designers present their ideas to the user, client and manufacturer as models, mock-ups, prototypes and computer generated 3D models.

- Model - a scaled down graphic representation of a design.
- Prototype - a life size working model of a design used for testing development and evaluation.
- Mock-up - a model of a product built for study, testing and display
- Computer Generated 3d modelling – modelling software is used to create a realistic rendered model of the product.

Model making can be a very quick and cheap method of producing a prototype. Suitable materials include paper, card, foam board, styrofoam™, wire and 3mm MDF. Users, clients and manufacturers use models to evaluate ideas and decide how well they meet their needs and how best to make it.

Modelling - Styrofoam

There are many ways to build models. Some materials are more suited to making a certain type of model than others.

Styrofoam–This material is good for making block models as it is very easy to cut and form into thick 3D shapes. Styrofoam comes in large sheets, which commonly range from 25mm to 110mm thick and is usually coloured blue or pink. Styrofoam can be cut using a craft knife, fine bladed saw or hot wire cutter and shaped using sand paper, files or a surform. When cutting or sanding styrofoam, a dust mask and eye protection must be worn.

http://youtu.be/YlNmKrCynhU

Modelling – Clay

Clay–This material is good for making block models and more complicated mode ls as it is very easy to cut and form into thick 3D shapes. One mayor advantage of using clay is that if you make a mistake or change the design, this can be easily done by adding or taking more clay away.

http://youtu.be/eUz75_8gPs0

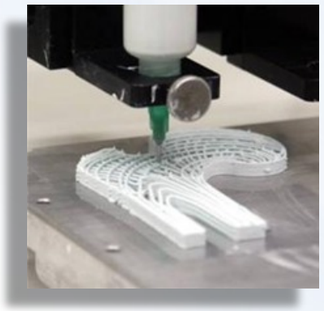
THEORY modelling

Modelling – Rapid Prototyping

What is Rapid Prototyping

Rapid prototyping is the name given to a number of processes used to turn CAD models into 3D objects very quickly. The process is normally carried out on a 3D printer which uses plastic such as ABS to construct the model. The printer melts the plastic through a nozzle onto a base board into the shape of the product. The printer does this a layer at a time building up into the completed model.

http://youtu.be/1gzkCuLGzn0



Computer Generated 3D Modelling

Computer 3D Modelling - The development of 3D modelling software enables designers and engineers to create realistic 3D models of their designs. A 3D computer model is a virtual object which can be rotated on screen and viewed from any angle.

Advantages of computer 3D modelling

- Models can be produced very quickly.
- Models can be modified very easily.
- You can easily add colour & surface texture.
- You can test structural designs before building eg bridges & skyscrapers.
- Easily sent by email to remote locations throughout the world.
- Less storage space required than a 'real' model.
- Used to create realistic simulations.
- Clients can explore virtual 'walk through' of 3D model designs.

Disadvantage of Computer 3D modelling

- Computer generated models are virtual and can lack the feel of a traditional model which can be picked up and handled.

THEORY computer aided design

Computer Aided Design/ Draughting is the use of computer systems to assist the creation, modification, analysis, or optimisation of a design.
Computer-aided drafting describes the process of creating a technical drawing with the use of computer software. CAD software is used to increase the
productivity of the designer, improve the quality of design, improve communications through documentation, and to create a database for manufacturing. As in the manual drafting of technical and engineering drawings, the output of CAD could convey information, such as materials, processes, dimensions, and tolerances. CAD is an important industrial art extensively used in many applications, including automotive, shipbuilding, and aerospace industries, industrial and architectural design, prosthetics, ar more. CAD is also widely used to produce computer animation for special effects in movies, advertising and technical manu

Advantages of CADD
Drawing speed - Although it takes a considerable amount of time and financial investment by companies to train their CADD operators. It will save time in the long term as drawing production is more accurate much faster using CADD software opposed to traditional methods. Files can also be sent instantly through emails. In turn, this will help increase productivity generating more income for companies.

Ease of modification - Companies who use CADD systems have advantages over competitors who rely on more traditional methods of modifying drawings. The ease and speed with which modifications can be made reduce time and costs, which in turn increases productivity.

Drawing size and flexibility - Drawings can be enlarged or reduced with no loss of detail. Extremely fine, detailed work can be produced using commands such as ZOOM. Positive location tools such as GRID, GRID SNAP and ATTACH enable accuracy to be maintained even in the smallest details.

Repetitive elements (library) - Drawings can contain a number of repetitive elements such as doors, windows, kitchen fittings and appliances. It is useful to have these items stored in a CAD library file. CAD library files are available for mechanical engineering, architecture and electronics. Items that you design need only be drawn once, saved to a library file, then retrieved and positioned each time they are required on a drawing. This saves time and effort, which increases productivity.

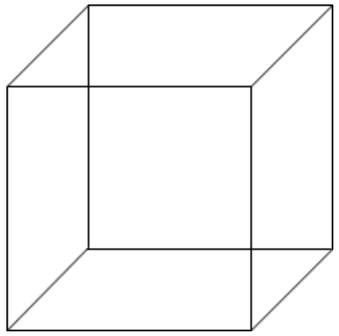
Storage and retrieval - A completed drawing or series of drawings can be stored on a hard drive, removable USB storage device or CD-R. These formats require less storage space than paper drawings. The drawings can then be printed as many times as required with no deterioration in quality.

Standardisation of drawings - Standardisation of drawings is often determined by drawing standards such as BS 8888. Standardisation of drawing layouts and styles can easily be created in the 'in-house' or corporate style adopted by the operator or the company.

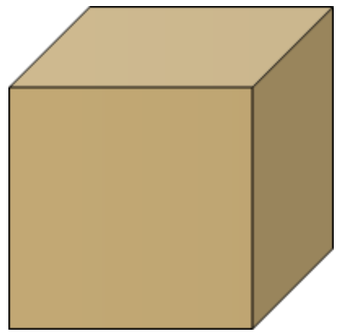
THEORY computer modelling

Types of Models

Wire Frame



Solid



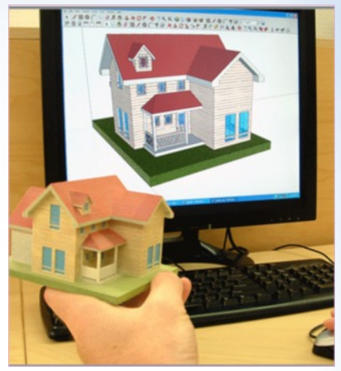
Real Time

These are the main types of computer models used by designers of animation or simulation.
Models start off as 'wire frame' then are made 'solid' and finally given the image of being 'real time' as in a movie production or a training simulation environment.

Animation is where computer models perform as in entertainment e.g. films. Simulation is where models create a virtual reality where humans can interact with events and change the outcome e.g. aircraft pilot training etc.

Computer Models Vs Hand/Machine Made Models
The development in 3D modeling techniques enables designers in different industries to create 3 dimensional models of their concepts quickly and easily.

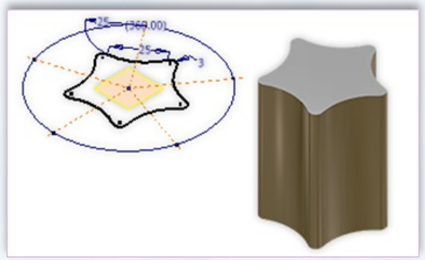
Hand/Machine Made Models
These models are very useful for designers when determining how a design may look or feel before moving to the next stage of design. Previously, 3D models had to be built manually from materials such as card, clay and polystyrene blocks. Nowadays, advances in technology have enabled 3D printers to become a reality, allowing the user to produce accurate real life models. Although this gives the benefit of being able to touch and hold the model it means another model would need to be created to take into consideration any changes or modifications that may need to be made. It can also be quite time consuming to produce these models.



Computer Generated Models
These models are much quicker and easier to create and edit. Modifications can be done at the click of a button, eg . Shape, colour, texture, scale, degree of accuracy. They can also be seen to function in any given environment. They obviously take up less physical space as they are stored electronically and designs can be sent instantly over the internet to clients and other designers. Unfortunately they cannot be physically touched for feel of comfort or control.

THEORY modelling tools

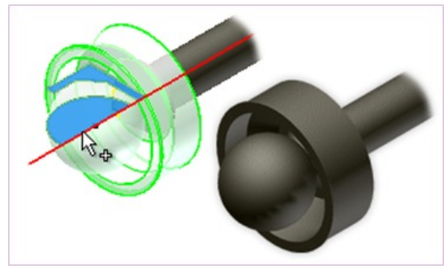
Extrude

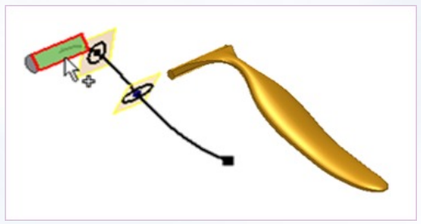


The extrusion tool is used to add depth to a sketch to transform it into a 3D model

Revolve

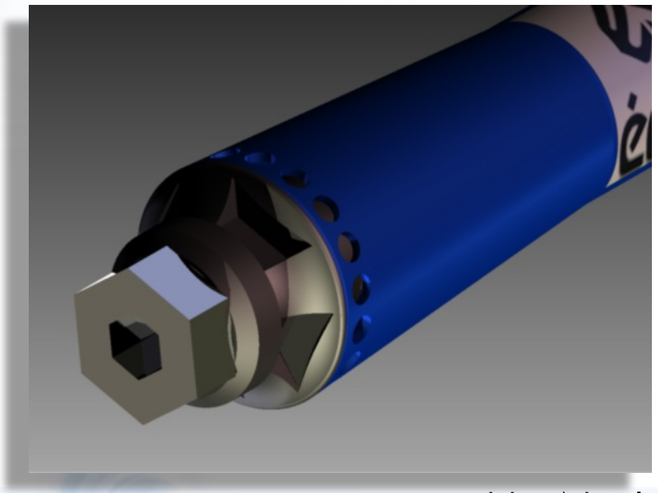
Creates a 3d model or feature by revolving one or more sketched profiles around an axis.





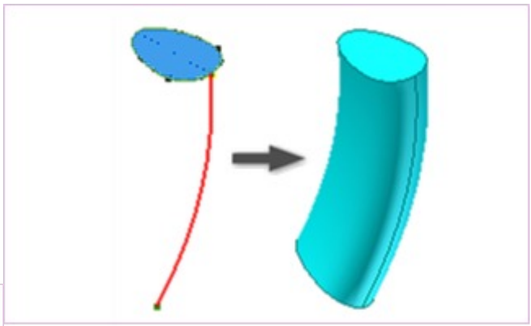
Loft

Creates a model or feature by blending multiple profiles (sketches) called sections, and transitioning them intmooth shapes between the profiles or part faces.



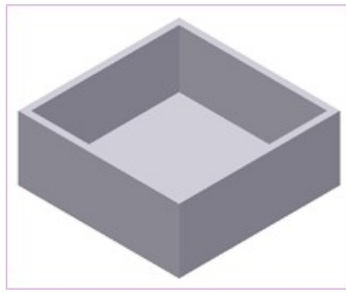
Sweep

Sweep models or features are created by moving or sweeping one or more profiles (sketches) along a path. If using multiple profiles, they must exist in the same sketch. The path can be an open or closed loop, but must pierce the profile plane.



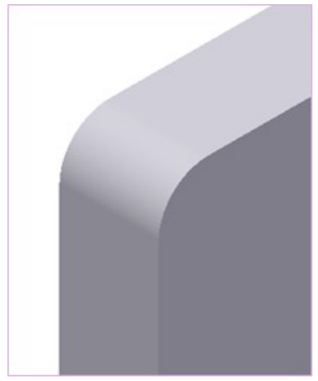
THEORY modelling tools

Shell



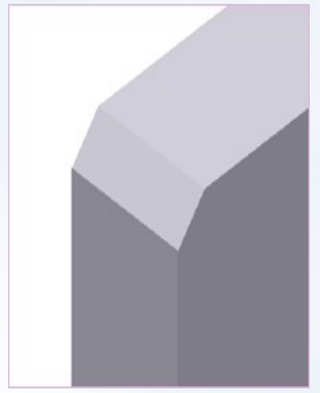
The shell tool allows you to remove surfaces and hollow out any shape or feature. The wall thickness can also be edited .

Fillet



The fillet tool allows you to round any selected corner or edge on a model. Multiple edges and corners can be filleted at any one time and the size of the fillet can be easily edited

Chamfer

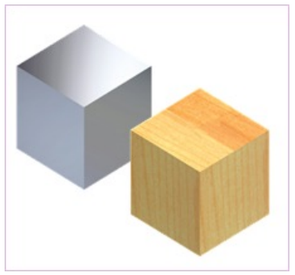


The chamfer tool allows you to remove an angular section along any selected corner or edge. Again, multiple edges/corners can be chamfered at any one time and the size can be easily edited

Inventor Studio

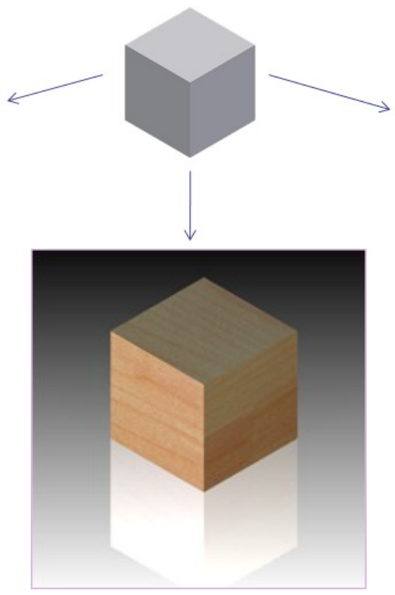
Within Inventor, you will find 'Inventor Studios' in the 'Environments' tab.
This part of the software, allows you to create a more realistic image of your work through the use of materials, scenes and light sources.

Materials



Your model can be quickly and easily enhanced by Selecting appropriate materials for different parts of your inventor model. Each material choice can be edited to make it more unique and even more realistic.

Lights



Adding lighting allows your rendered image to take on shadows and reflections. You can choose from preset styles or make your own to produce a high quality effect.

Scene

Adding a scene allows you to incorporate a background colour or image to enhance your presentation. Scenes are only visible during editing and the rendering process.

THEORY animation & simulation

The development of technology and computer software has changed the way in which graphics can be produced. Recent advances have enabled designers to create complex and realistic graphic images quickly and easily. Two examples of this are animation and simulation.

Computer Animation

Animation allows a designer to create on-screen movement of graphic images along a set path (to form a video clip). It is quick and easy to produce a realistic impression and is used to increase visual impact of graphics on the viewer. A product with moving parts can be animated to demonstrate how it fits together and operates.

Computer Simulation

Computer simulation is used to imitate or predict behaviour in a real life or hypothetical situation. This provides a virtually realistic experience for the user within a safe simulated environment. By changing the variables within the software, predictions can be made about the behaviour of a System. Computer simulation is beneficial for training purposes, eg, 3D simulators are commonly used to train pilots how
To manoeuvre their planes in dangerous conditions.

http://www.youtube.com/watch?v=P_6xsA0gZE4 - Medical Uses

http://www.youtube.com/watch?v=BUHKMIr5E1E - Geographical Uses

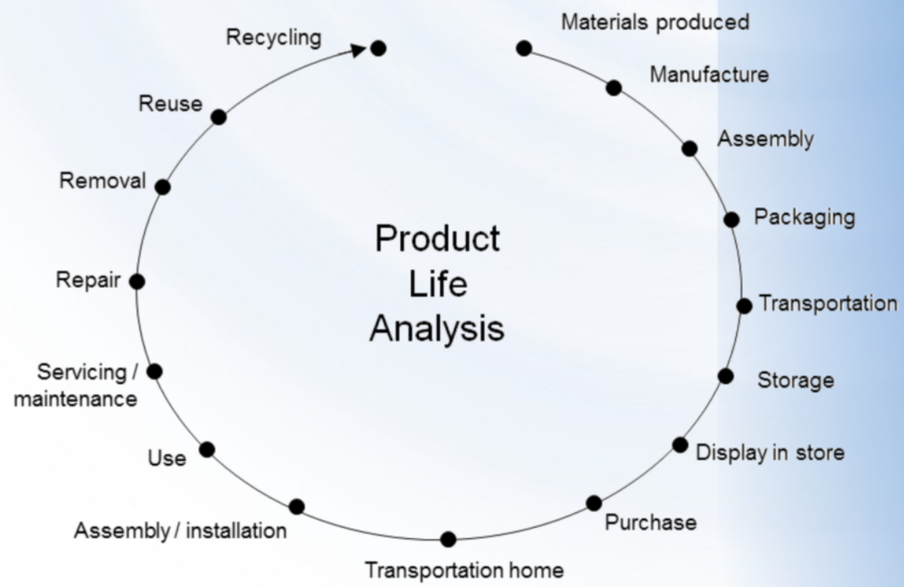
http://www.youtube.com/watch?v=orUsJV31H3o - Industrial Uses

http://www.youtube.com/watch?v=i92aQVW0mC0 - Training Uses

THEORY environmental considerations

Three key considerations of the environment should be kept in mind: Pollution, Aesthetics, Sociology
Environment and pollution
Pollution is created by the manufacturer – during the making of the product, its use and/or its disposal at the end of its life. Designers have a large responsibility to the environment and must try to keep pollution to a minimum in their designs.

During each stage of a product's life, its human, environmental and economic needs should be considered and investigated. This is often referred to as the cradle to the grave approach which examines the environmental impact from the production of the raw materials all the way through to the disposal of the products at the end of its life.



Some products are advertised as being 'environmentally friendly'.
For this to be true these conditions must apply:

- The use of finite resources must be avoided
- Most materials should be recyclable (>90%)
- The processes used in manufacture should not pollute the environment
- The waste products produced during manufacture should not cause pollution
- The operation and maintenance of the product should not pollute the environment
- The disposal of the product at the end of its useful life should not pollute the environment

At all stages in the development, manufacture, use, and disposal of a product, environmental issues have to be considered:

Can the product be made from renewable materials?
Are the proposed materials recyclable?
Is the product and manufacturing processes energy-efficient?
Can natural power sources be used?
How will the product be packaged?
Can the product be easily repaired?
Are the materials biodegradable?
How will it be manufactured?
Is it made using local skills and materials?
Are the power sources used rechargeable?
How will the product be transported to the market place?
Have waste and by-products been kept to a minimum?

Have all the types of pollution (noise, smell, chemical and air) been kept to a minimum?
It is clear then that these limits will have major implications for the design and cost of the product?

THEORY environmental considerations

Environment and aesthetics

The designer has the ability to create products in any style he/she chooses. It is possible to design products that merge well with their environment or alternatively those that contrast with their surroundings. Products which harmonise well with their surroundings are pleasing to the eye but might be considered boring by some. A bus shelter May be designed in mock Georgian style to blend in with the surrounding architecture. However, this "safe" approach can create an environment which could be described by some as monotonous.

Alternatively the designer might choose a modern design to contrast with the existing buildings. She/ he might use modern materials such as steel and plastic and incorporate features such as integrated lighting so that the shelter stands out day and night. This concept can be seen in the glass pyramid metro entrance at the Louvre in Paris. This bold approach to design can be shocking and often attracts controversy, particularly in relation to architecture. Such an approach can be interesting and exciting to some people and yet offensive to others. The designer then has to come to a decision regarding the impact the design will have and then decide if it is acceptable.

Environment and sociology

Studies show that if we simply alter the lighting from day to day in a factory, it will improve the output of the workforce. It is not the quality of the light but rather that there has been a change that causes this. A changing environment is more stimulating and therefore more motivating than a static one. Products such as computers or even hair dryers all have a bearing on our general state of mind, particularly in a society where people lead very busy lives. The feelings of frustration we feel when a product fails to function are commonplace. Well designed products should be pleasing to use, reliable and do the job they were designed to do. In catering for the needs of the individual the designer must consider age, culture and physical ability/disability. They all have an effect on a user's reaction to the product.

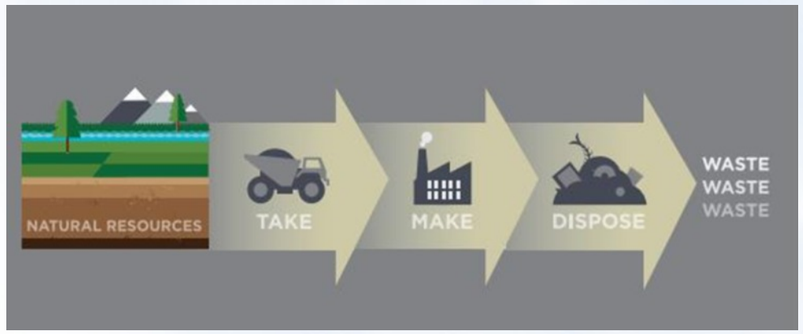
A designer must try to make new technology as user friendly as possible; for example 'high tech' products can be threatening to older people because they do not understand how they work, which makes them feel insecure. Care must be taken that a design does not cause offence to a particular race or culture. Many products do not take into account the problems of the elderly, disabled or very young. In particular handles and switches are often too small or difficult to operate. With some thought many of these problems could have been avoided. Good design will take account of as many users as possible.

People's lifestyles have changed over the years and these sociological factors have an effect on Product Design. Today leisure time is seen to be very important. Factors that would have been important even thirty years ago are seen as unimportant today. Tasks such as cooking and cleaning have to be quicker and easier to do, hence the increase in the use of things like precooked foods, microwave ovens and dishwashers. People therefore now have more leisure time and this has increased demand for items like stereo systems, video and more recently home cinema. Linked to this has been the increase in the use of sports / leisure equipment such as exercise bikes, jogging machines and sun beds.

THEORY circular economy

The circular economy is a new way of thinking about how we manufacture, use and then discard the products we use.

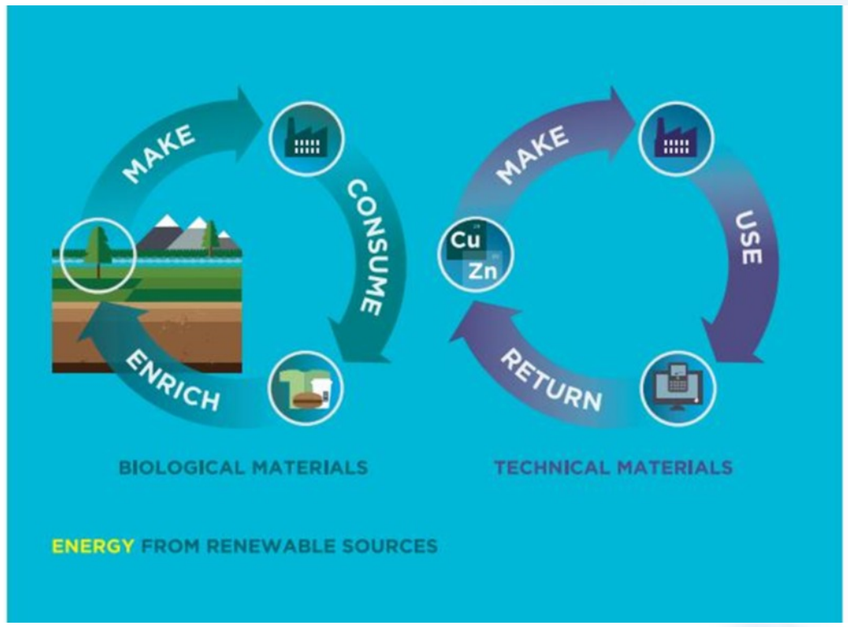
This is what usually happens with products - they have a linear life cycle. We take away natural resources to make them. We make them using energy and then we dispose of them - usually in Landfill. This is damaging our environment



Sometimes we reduce the amount of goods we use, or reuse it (eg charity shops) or we recycle them. But sometimes this is not enough. Often we we recycle products the new product that can be made from the materials is not of a very good quality or it has been 'downcycled' into a product such as bin bags.

A new way of thinking is the Circular Economy. - The circular economy promotes products that have A much longer life cycle, that can be reproduced into a better (upcycled) or equivalent product. The Key is that there will be less waste needing to be put to landfill

http://www.youtube.com/watch?v=zCRKvDyyHml



THEORY circular economy

Here are a selection of short videos to get you thinking about approaching design differently. Some companies have come up with creative ways to help the environment. - And do be more aware of the circular economy

The Clever Little Shopper

http://www.youtube.com/watch?v=ZH2Z16t13Yw

Replenish

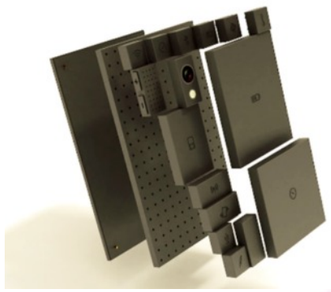
Cleaning products

http://vimeo.com/48159392

PHONEBLOKS
A PHONE WORTH KEEPING

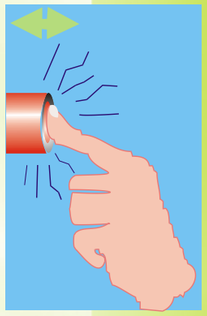
SmartPhone

http://www.youtube.com/watch?v=oDAw7vW7H0c



HOMEWORK design 1&2

Homework 1



1. Shown opposite is a picture of a finger pressing a button. What anthropometric data would be required when designing such a button.(1)

2. What is the best method of tackling a design brief?(2)

3. In your own words, briefly explain four stages of the DESIGN PROCESS. (8)

4. Explain the advantage of including an exploded view as part of a design folio.(2)

5. When designing s door way what percentile of people do we design for and why is this so?(2)

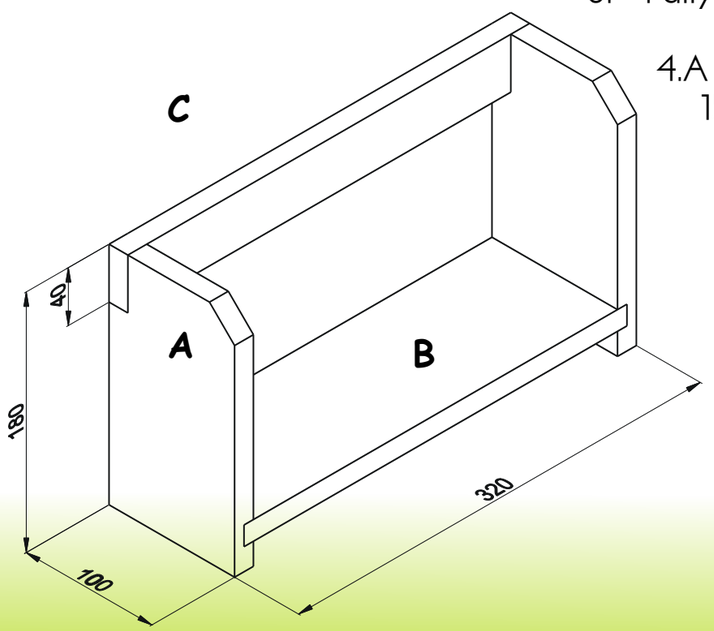
6. State three reasons why a manufacturer would choose to use a flat pack rather than having his/her product fully assembled before delivery. (3)

Homework 2

1. Shown opposite is a picture of an office chair. If you had to design a new range of office chairs what three Ergonomic factors would you have to consider when designing it. (3)

2. Explain the purpose of carrying out an Analysis when carrying out the design process. (2)

3. Fully explain the purpose of a Design Specification. (3)



4.A drawing of a CD rack is shown below. Assuming the material is pine and the thickness is 15mm, in the table provided construct a cutting list of all the component parts. (9)

Material	Part	Quantity	Width	Thick	Length

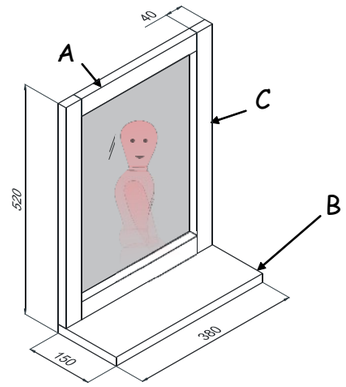
HOMEWORK design 3&4

Homework 3

1. Shown opposite is a picture of a hand held power drill. What two ergonomic factors would be required before designing such a tool. (2)

2. Why would it be a good idea to make a miniature model of your final design idea with modelling clay or some other basic material before making the finished article? (2)

3. When designing everyday products we design for a certain percentage of people, what is this percentage and why is this so. (4)

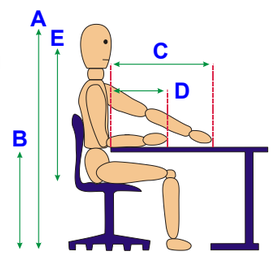


4. A drawing of a mirror is shown. Assuming the material is 10mm thick pine, in the table provided construct a cutting list of all the component parts. (9)

Material	Part	Quantity	Width	Thick	Length

Homework 4

1. If you were asked to design a mobile phone, why would it be important to take the 50th percentile sizes of both men and women? (2)

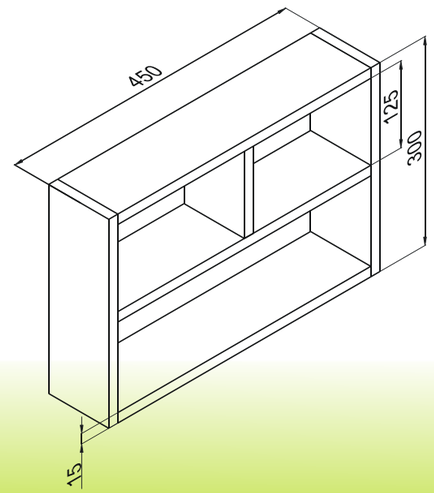


2. In the drawing opposite, an ergonome is shown sitting at a desk. If you were asked to design the desk, what two factors would have to be considered to ensure it's suitability? (2)

3. When evaluating and testing a finished designed product, why is it important to compare the final product with the specification. (3)

4. A picture of a shelving unit is shown, assuming the material is mahogany and the width is 100mm, in the table provided construct a cutting list of all the component parts. (9)

Material	Part	Quantity	Width	Thick	Length



HOMEWORK design 5&6

Homework 5

1. Why is the presentation drawing a very important aspect of the design process? (2)

2. Why is it important to write a sequence of operations? (2)

3. Briefly explain the purpose of the Initial Ideas stage of the design process. (2)

4. Name four important factors that need to be considered when carrying out detailed research. (4)

5. Briefly explain what is meant by the term ERGONOMICS. (2)

6. Briefly explain what is meant by the term ANTHROPOMETRICS. (2)

7. Shown opposite is a picture of an ergonome sitting on a bike. List five ergonomic factors which would require to be considered when designing a bike. (5)

Homework 6

1. Aesthetics is a very important part of the design process, fully explain what the term aesthetics means. (3)

2. Explain why the use of an Ergonome is an ideal method for a designer to test his product. (2)

3. In your own words, give a full explanation for the purpose of carrying out Market Research prior to designing a new product. (3)

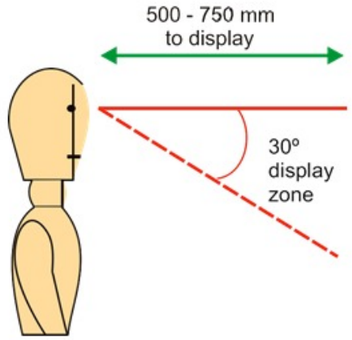
4. State three reasons why a manufacturer would choose to use a flat pack rather than having his/her product fully assembled before delivery. (3)

5. A designer is about to embark on the design of a mobile phone which will be used by both men and women. Why would he use the 50th percentile size of both their thumb lengths? (2)

6. Briefly describe the purpose of a Knock Down Fitting and where it may be used. (2)

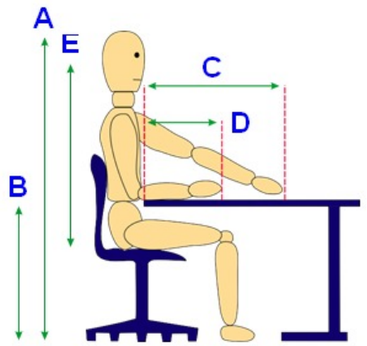
HOMEWORK design 7

Homework 7



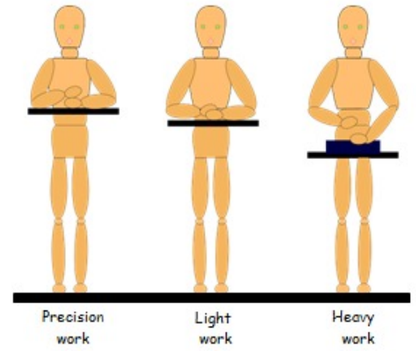
We all know supermarkets sell products, but why are the shelves not higher than they are. They could store a lot more food etc if they were higher There are several reasons they are not: firstly, the average sized person could not reach them and secondly, they could not see what is on the shelf. Another important factor when designing shelving is to ensure the correct height is established for people looking at the products. If a customer has to reach for a product that is too high for them, they could over balance and cause the products to fall the ground.

1. Can you think of two other situations when the designer would need to consider how far the user can reach?



In the picture opposite, factors which would have to be considered when designing a table, would be to ensure the table was high enough to clear the persons legs but not too high to work at so as to make the working height uncomfortable. The reach of the person is also very important. If the desk was too wide the person would not be able to reach anything at the far edge.

2. Can you think of any other products that the designer would need to consider the height of the user?



This picture shows three different table heights for a person to work. If the object being worked upon was very heavy, the person at the higher work surface would tire very quickly. It would be more beneficial to work at the lower height. The higher work surfaces are more suited to light or precision work.

3. Can you think of any other products that the designer would need to consider how much force the user needs to apply to use it or to make it work?

HOMEWORK design 8a

Writing a Specification

Specification – Homework 8

What is a specification?

The 'specification' is probably the easiest part of the design process although it is one that pupils tend to neglect or write incorrectly. It is usually a list of points, with each point referring to the research work. To gain the higher levels in the specification you need to show what you have learnt from the research that you collected and presented in the research section.

1. Can you think of as many things as you can that the designer thought of before designing the phone to the right? In your homework jotter write down Ten things.

2. You have been hired by a handheld torch manufacturer to design a new torch for younger people. The first job they want you to do is to create a specification for them that is realistic.

Things you may want to think about are:

- Who is the torch for?
- What will the torch be made from?
- How big will the torch be?

3. There are many important points you need to consider before designing a torch. Produce a list of things you think are important about the design of the torch - you should aim to write at least ten items.

This list is a very basic specification.

To write a full specification more information/thinking is involved. The main difference between a basic specification and a full specification is that all points must be appropriate to the task(appropriate to what you are designing) and some of the points must be measurable.

A measurable specification point is something that can be measured/tested against after you have designed your product.

HOMEWORK design 8b

Example
Below I have written 3 simple specification points for a new handheld controller for a Playstation.

- Must be one colour.
- Must include buttons.
- Must include the 'Sony – Playstation' logo.

The above points are non-measurable. Below shows you the non-measurable and the measurable points side by side. Measurable points give you more information.

Non – measurable	Measurable
1. The controller must be one colour. 2. Must include buttons. 3. Must include the 'Sony – Playstation' logo.	1. The controller must be made from black plastic. 2. Must include 10 buttons including an on/off button. 3. Must include the 'Sony – Playstation' logo on the front face of the controller so people can identify it with Sony Playstation.

Below you can see a list of specification points for a mobile telephone. In the 'measurable' column write down the measurable version specification point. Number 1 is completed for you.

Non-Measurable	Measurable
1. The phone must be a good size.	1. The phone must be no bigger than 120mm tall, 75mm wide and 25mm thick.
2. The phone must be colourful.	2.
3. The phone must include buttons.	3.
4. The phone must be aimed at younger people.	4.
5. The holder should be colourful.	5.
6. The phone must have a screen.	6.
7. The phone must be durable.	7.
8. The manufacturer's logo must be included.	8.
9. The key size must not be too small.	9.
10. The numbers must stand out on the keys	10.

You should now have a good idea what a measurable specification point is.

HOMEWORK design 8c

Specification –

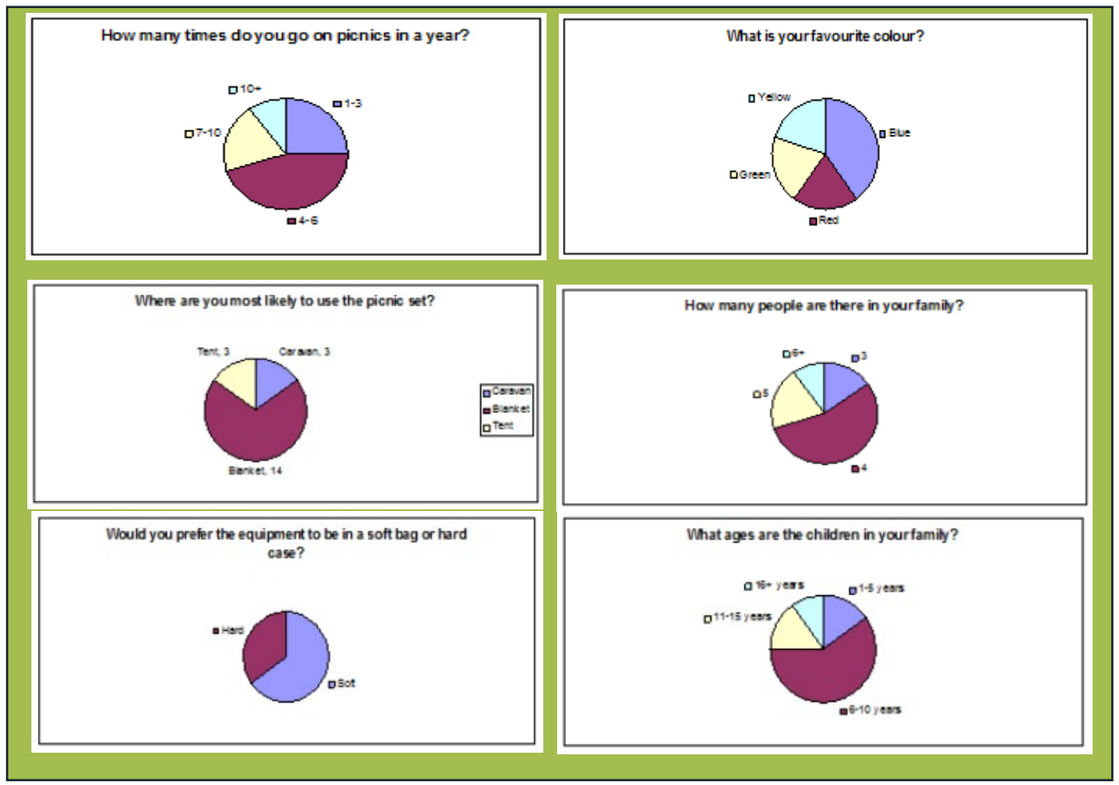
1. What are user's views and how would we gain them? Why are they important?

You need to take some users views into consideration before writing your specification. If we didn't then the product we are designing may not be liked by them.

Below you will see a small survey. From this survey we can take important information to include in our specification.

Customer/Users views

These results are taken from a survey of 20 families.



What can I use from this survey? What have I found out?

- Three quarters of families go picnicking no more than 6 times in a year.
- I know that from the people I surveyed the favourite colour was blue.
- At least half of the families have 4 people in their family.
- The most likely place they would use a picnic set is on a blanket.
- Most would prefer the picnic set to be in a soft case.
- 6-10 years was the most common ages of children in families asked.

This information is valuable to write a specification. I can use this information to generate a good specification with users views included in it.

1. Using the information gathered in the survey, write a specification for the 'picnic set'

Eg

1. The picnic set must be easy to store when not in use (*I chose this because the set is only likely to be used 6 times a year)*

HOMEWORK design 8d

This information is valuable when writing a specification. I can use this information to generate a good specification with users views included in it. Write a specification taking into account what you have learned from the customer survey. The first two have been done for you.
Complete the specification for the 'picnic set'

1. The colour of the picnic set is going to be blue as this was the highest chosen colour in my survey.

2. My picnic set will be designed to fit in a soft case so it can be carried easily as more people in the survey wanted this.

3.

4.

...

15

Homework 9 Product Evaluation

Two kettles are shown below. We can clearly see that the Aesthetics of each are very different.

Alessi 

 Braun

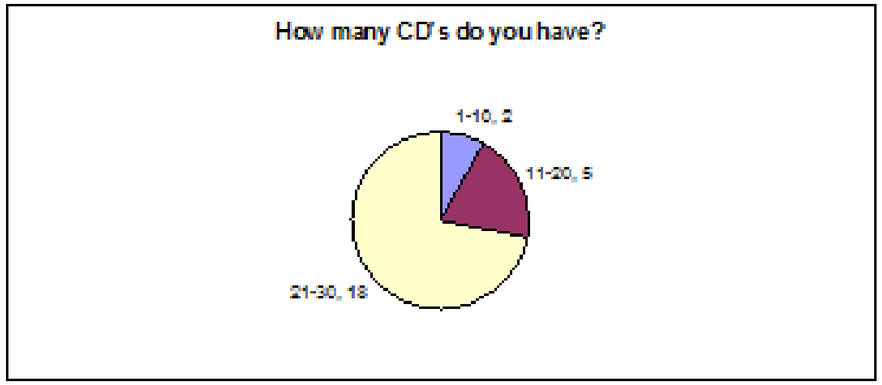
Describe each kettle design in relation to their appearance and the materials used and try to give reasons why each has been designed in this way.

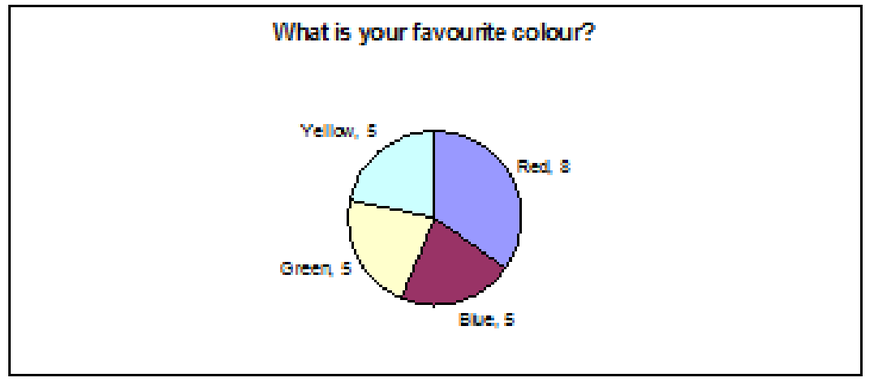
Which kettle do you think would be the easiest to use and why?

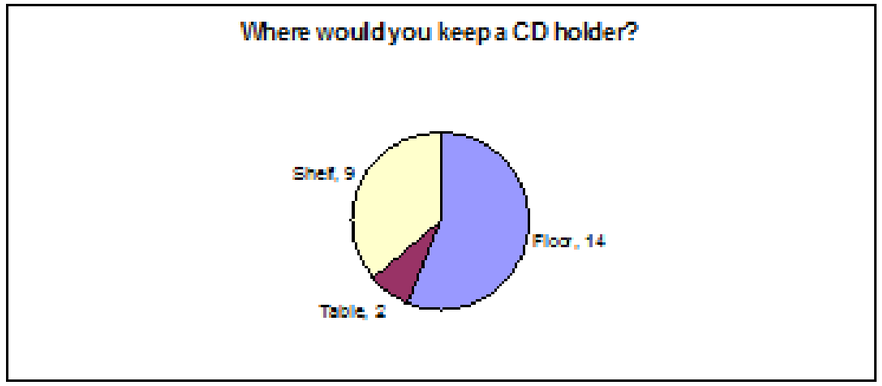
HOMEWORK design 8e

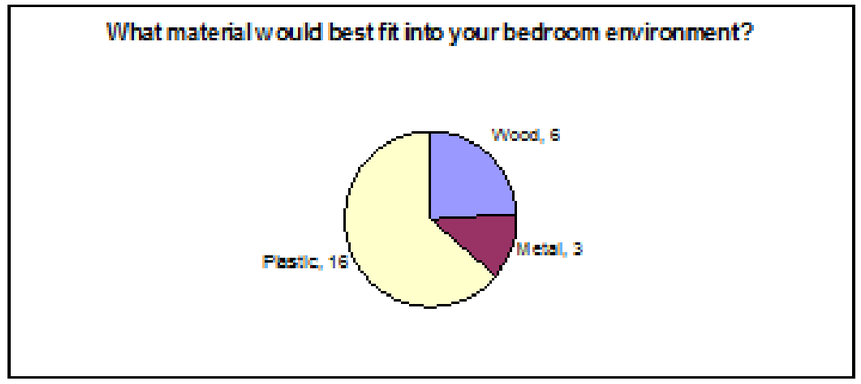
Specification –

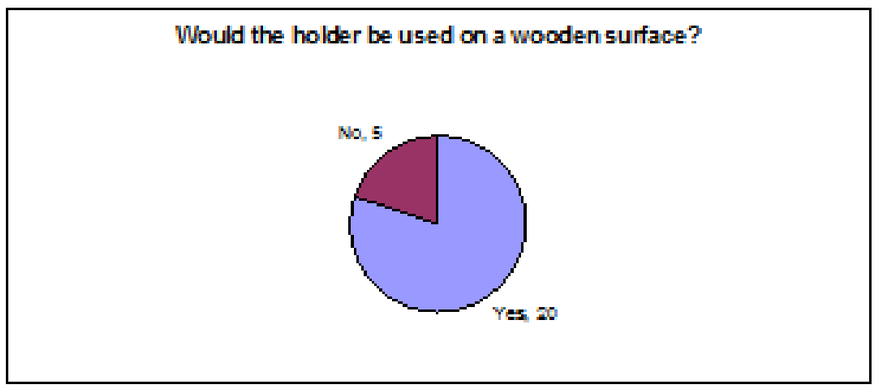
You are to write a design specification for a CD holder using the information below from a small customer survey.
25 people were asked the following questions.











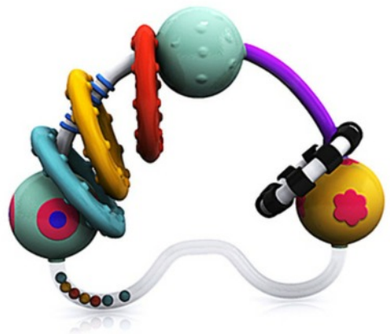
Other things to think about: Sizes, height, target market, age of user, cost, safety etc
To gain a Nat 5 you need to have done the following.....

- My specification must include 3 appropriate measurable points within a
- 10 point spec
- My specification has some users' views included in it

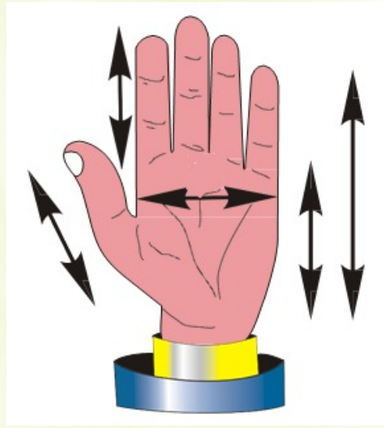
HOMEWORK design 9

Annotating

In your homework jotter choose one of the products below, sketch it onto your page and annotate it using the system AccessFm .



HOMEWORK design 10

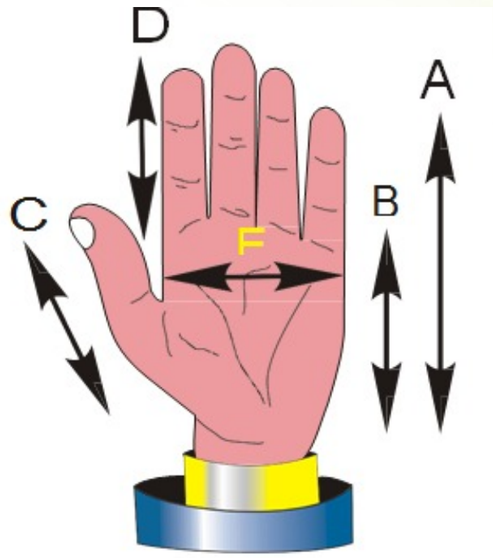


The table below lists each part of the hand and also shows a 5th, 50th and 95th percentile for both men and women. The reason for this, is that men's hands are generally larger than those of women and therefore if a telephone was being designed, it would be designed with both men and women in mind.

Anthropometric estimates for British adults aged 19-65 years (in mm)				
Dimension	*5th %ile*	*50th %ile*	*95th %ile*	
A Hand length	173	189	205	MALE
	159	174	189	FEMALE
B Palm length	98	107	116	MALE
	89	97	105	FEMALE
C Thumb length	44	51	58	MALE
	40	47	53	FEMALE
D Index finger length	64	72	79	MALE
	60	67	74	FEMALE
E Hand breadth	78	87	95	MALE
	69	76	83	FEMALE

Looking at the table the percentile that we are concerned with is the 50th %ile. Try adding together the 5th %ile and the 95th %ile for each category and then divide by two. What figure has this given you? Your result should be equal to the 50th %ile.

Using the information in the table work out which sizes a designer would use for the design of a mobile phone that would be suitable for males and females. Draw your sizes on the hand below.



HOMEWORK design 11

Aesthetics & Function

1. State what is meant by the term function?

2. Products are designed to perform a primary function but in order for them to function and perform efficiently and safely, they must also have secondary functions.

(a) State what the primary function of a steam iron is.

(b) List three secondary functions of the iron.

(c) Describe two factors that would influence how well the iron performs

3. Two digital radios are shown below. Both perform the same function. However designers need to strike a balance between aesthetics and function.

Roberts DAB radio

Ruark Vita DAB radio

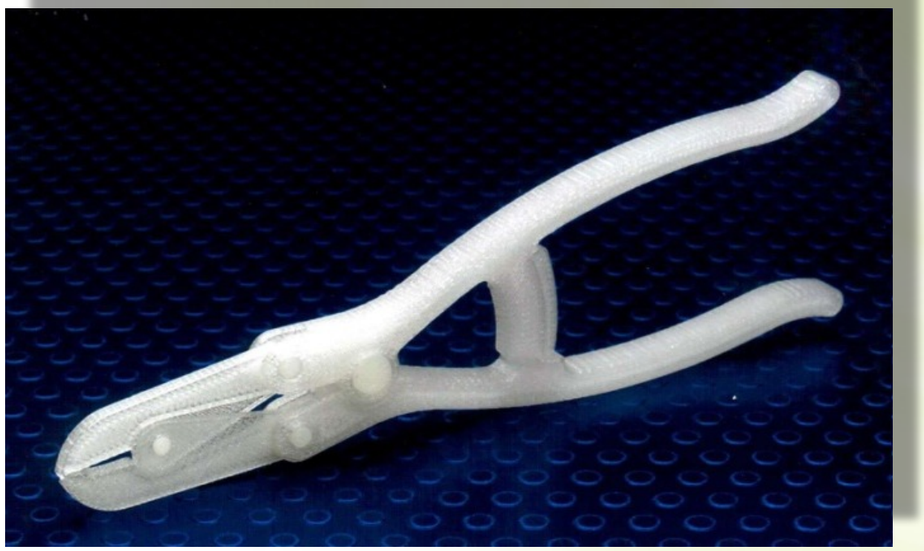
(a) Explain which radio you think has been designed with an emphasis on aesthetics and which has an emphasis on function.

HOMEWORK design 12

Mass Production

1. State what is meant by the term mass production.

2. Rapid prototyping is commonly used in industry to test prototypes.



(a) Describe what rapid prototyping is.

(b) What is a prototype?

(c) At what stage in the design process might a designer produce a rapid prototyped model?

3. Computers are used to control a wide range of mass production processes. Describe two advantages of this to the manufacturer.

4. Mass production techniques have made it possible to manufacture high volumes of products very quickly to meet the growing demands of consumerism.

(a) What impact do you think this will have on the environment?

(b) What can designers do to limit the impact on the environment?

HOMEWORK design 13 & 14

Design Folio/Factors

1. List the 8 stages of the Design Process.
2. What detailed Design Factors should be considered when researching a new Product's Design?
3. What is a Product Specification?
4. When undertaking the Idea Generation Stage of the design process, what are ANNOTATIONS?
5. What are some things that should be considered when developing some of the Initial Ideas further?
6. What four pieces of information should be included when doing the "Planning for Manufacture" stage of the folio?
7. What should be considered when writing an Evaluation?

.....

Target Market

1. (a) State what is meant by target market?

(b) In order for a designer to ensure that a product is as successful as possible they must carry out market research. Describe two ways this can be done.

(c) What three things must the potential buyers of a particular product have in common?

2. Two cameras are shown below. They both perform similar functions but are intended for entirely different target markets.

Canon EOS 450D, £450

Fujifilm Finepix, £75

(a) Suggest a suitable target market for each of the cameras. Consider age, gender, interest, lifestyle, income and usage when describing the target market.

HOMEWORK design 15 & 16

Aesthetics

1. (a) State what is meant by the term Aesthetics. (b) Describe two reasons why aesthetics is so important in the design of products.

2. Two contrasting examples of car design are shown.

(a) Explain which of these designs appeal to you most. The following terms can be used to help in your explanation: Shape, form, colour, line, proportion, contrast, texture.

3. There are many kettles to choose from on the market today. Two examples of these are shown here.

(a) State what is meant by the term Style.

(b) Describe how you think each of the designers have achieved the different style of kettles.

Breville 'high-tech' Kettle

Morphy Richards

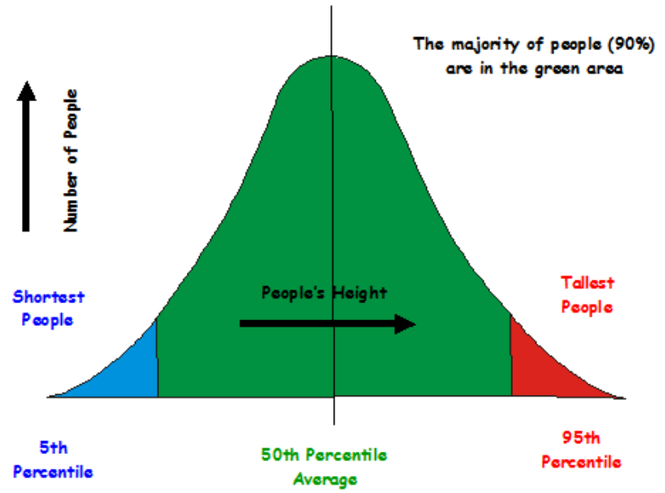
'retro' kettle Homework 19 The Market

1. Briefly describe what is meant by a "TARGET MARKET".
2. What 3 factors dictate the size of a potential market of a product?
3. What are the 4 "P's" when talking about marketing?
4. Now that you know what the 4 "P's" stand for what does each one mean?
5. What is meant by "Impact of decisions"?
6. What is the difference between product "needs" and product "wants"?
7. What would it be called when a product is targeted at a very small section of the market?

HOMEWORK design 17 & 18

Ergonomics & Anthropometrics

1. What is meant by the term "Ergonomics"?
2. What is an "Ergonome"?
3. What size of person are most things designed for, and why are they designed for th em?
4. What is Anthropometry?
5. Why must a large sample of people need to be measured to get accurate an- th ropometric data?
6. What does the 0-5th percentile show in the graph?
7. What does the 95-100th percentile show in the graph?
8. If you had a product and wanted to sell it to the most amounts of people, what percentile should you take your data from?
9. If designing a product why would you have to consider sizes of men and women separately?
10. Why do supermarkets not have their shelving go all the way up to the ceiling? Surely this way they could store a lot more items and save space...?



Aesthetics & The Design Team

1. What is Aesthetics and why is it an important thing to think about when designing a new product?
2. What colours do you think would be best for a children's toy and why?
3. What do we mean by "Harmony" when we are talking about design?
4. What could you do to help your design look "unified and organised"?
6. Why would a designer use contrast within a design?
7. What type of shapes would be classed as "geometric"?
8. What type of shapes would be classed as "organic"?
9. Draw a table and list each member of the design team in one column and what their role in another column.

HOMEWORK design 19 & 20

Ergonomics

Car designers invest a lot of money in developing car interiors to ensure that they are comfortable and it is easy to operate the controls within them.

(a) State **two** human dimensions that would need to be considered when designing the driver's car seat.

(b) What can designers do to make such controls easier to understand what aspect of the car they control? Give examples to illustrate your answer.

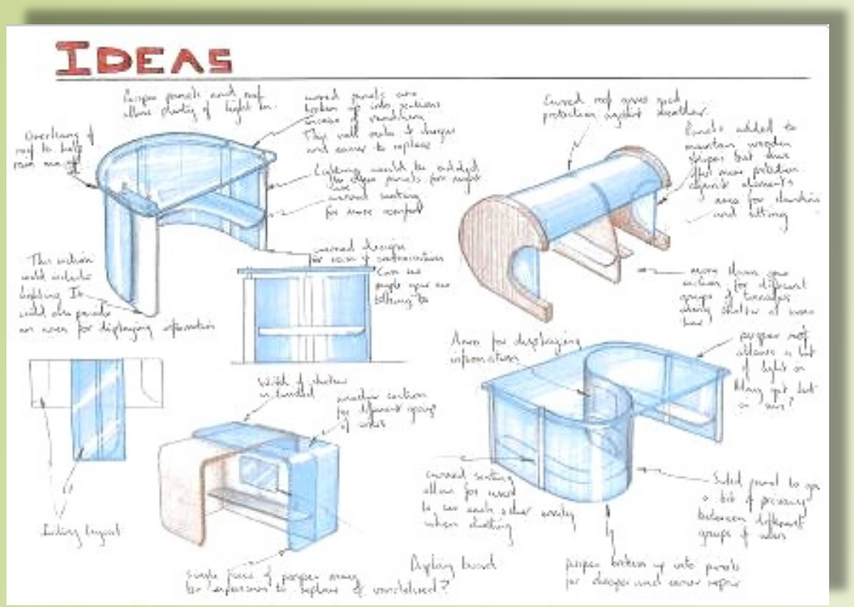
(c) When designing products, how can designers help to create the best fit and comfort for the largest percent of the population as possible?

(d) When designing the dashboard controls give an example of how physiology should be considered.

A sheet of concepts for a new shelter is shown. When developing these ideas ergonomics will need to
be considered.

(a) What percentile of standing height or stature will need to be considered to ensure that the
majority of the population will be able to stand under the shelter?

b) A scale model of a human was used during the design of the shelter. State the name of this type of
model.



HOMEWORK design 21 & 22

Planned obsolescence

Mass produced cars have built-in obsolescence.

- Explain the implications of this for the consumer and the manufacturer.
- List two other products which you consider to have built-in obsolescence.
- Often similar products are available with different life expectancies. Consider and compare the following for different ends of the market:

  •Cars
  •Razors/shavers
  •Pens

Design Factors

Before producing a specification for a computer mouse, the designer would have researched various design factors.

With reference to computer mouse design:

A) state four design factors which would have been researched;

(b) explain why each of these design factors is important.

HOMEWORK design 23 & 24

Function

A mobile phone's primary function is as a telephone (to make phone calls). List as many other possible secondary functions of a mobile phone as you can think of.

Design Factors

Children's cutlery is shown across.

During the design of children's cutlery, the designer would consider the
following areas:

Ergonomics Safety Aesthetics Materials.

Explain why each of these areas is important in the design of children's cutlery.

THEORY workshop safety

Workshop Safety

Safety is of major importance in any craft room, it is imperative that safe working practices are observed at all times. Failure to observe safety rules will result in that individual losing the privilege to work in the craft room.

Some general safety precautions

1. Work benches and machines must always be swept clean after use. Think of the person who has to use them NEXT.
2. ALWAYS walk when in the workshop, running causes accidents.
3. If sharp tools must be carried in the work shop they must be carried facing downwards.
4. ALWAYS work with sharp tools, blunt tools cause accidents.
5. Before any work commences all jackets should be removed and hung up. All bags placed under the workbench. Any loose cloth or hair should be tucked in or tied back.
6. Pupils should be familiar with the position and operation of the emergency stop buttons in workshops. ONLY press if an EMERGENCY arises.
7. Eye protection must be worn if operating any machinery.
8. Report any damaged tools, equipment, etc. to the teacher.
9. ALWAYS store tools in the well of the bench when not in use.
10. ALWAYS keep both hands behind the cutting edge when working with a chisel.
11. NEVER strike two hammer faces together. Flying metal chips could cause serious injury.
12. ALWAYS use a file fitted with a handle, tangs are sharp and very dangerous if used without a handle. If you are unsure what a tang is, ask your teacher, after all that is why they are there.
13. ALWAYS check machines to ensure that any rotating parts are properly guarded and free to rotate without obstruction, e.g. ensure before switching on that the chuck key is removed from the Jacob's Chuck. Never use a machine without permission from the teacher.

The Workshop is a Safety Zone

THEORY woods

Softwood

These come from coniferous trees (trees that have needle like leaves and last throughout the year). Unlike hardwoods these grow quickly and can be replaced quickly after being cut down. Softwoods are cheap.

Hardwood

These come from deciduous trees (trees that lose their Leaves every winter). they grow slowly and sometimes have twisted trunks. They are often not replaced when cut down and take a long time to grow. Their wood is expensive and used for high quality products

Name	Properties	Uses	Cost
Ash	Light in colour, flexible, tough bends well and varnishes well.	Tool handles, cricket/baseball bats, snooker cues, ladders and veneers.	Med
Beech	Mid-brown colour, hard, strong, tough, tends to warp but bends well.	High quality furniture, toys, tool handles and veneers.	Med
Oak	Light brown, hard, tough, heavy and durable outside. Gets harder with age.	high quality furniture, garden furniture, boats and veneers.	High
Mahogany	Red in colour, medium weight, quite strong, durable but warps easily.	high quality furniture, shop furniture, boat fittings and veneers.	High

Name	Properties	Uses	Cost
Red Pine	Straight grained, but knotty, quite strong and easy to work. Red/ orange in colour	Building construction. Needs good protection when used outside.	Low
Parana Pine	Straight grained with few knots. Quite strong and durable but warps easily.	High quality interior construction and furniture.	High
Spruce (whitewood)	Quite strong with few knots. Resistant to splitting but not durable.	Fitted furniture e.g. Kitchen cabinets.	Low
Cedar	Straight grained and knot free. Very light and durable. Quite soft	Shed construction and good quality fencing.	High

Timber is usually supplied in the following sections.

Planks - Vary from 38mm to 100mm in thickness and over 100mm in width

Boards - Less than 38mm in thickness and over 100mm in width.

Strips - Less than 38mm in thickness and less than 100mm width.

Squares - Square Section - thickness same as width.

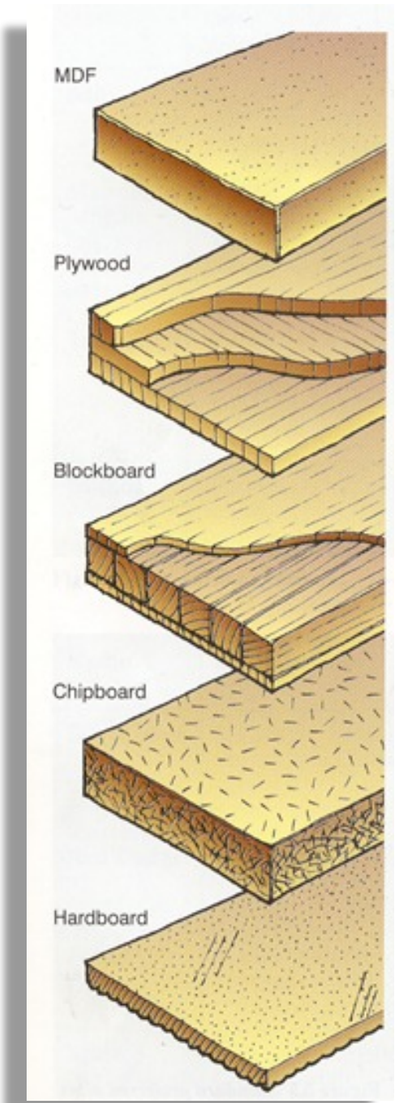
Dowel Rods - Dowel Rods, or cylindrical wooden pegs, are variable in sizes

THEORY manmade boards

Manmade Boards

These are made from waste wood left over from machining or working. All excess such as thin sheets (plywood), small strips/blocks (blockboard), wood chips (chipboard) and saw dust (MDF) are used to make boards.

Name	Properties	Uses	Cost
Plywood	Strong, stable, warps easily. Made by gluing layers of thin sheet wood together. It is important that the grain of each layer goes in a different direction to ensure maximum strength.	Bases of drawers or boxes. Backs of cabinets and wardrobes etc.	Med
MDF	Very strong and doesn't warp. Made from gluing and tightly compressing excess sawdust together.	Furniture and toys.	Med
Blockboard	Very strong and rigid and doesn't warp. Very heavy. Made from gluing strips/blocks of wood together.	Quality furniture, stage flooring and fire doors.	High
Chipboard	Heavy, warps easily and needs a good finish. Made by gluing and tightly compressing wood chips together.	Kitchen cabinets and worktops, roofing boards.	Low
Hardboard	Not very strong, warps easily and needs a good finish. Made similar to plywood.	Door panels, drawer bottoms and cabinet backs	Low



Manufactured boards have a number of advantages over wide wooden boards or planks:

- There is a limit to the number of wide boards that can be cut from a tree and this makes it expensive.
- Manufactured board is available in sizes up to 1525mm wide whereas hardwood is typically 300mm and softwood is 200mm maximum.
- Manufactured board is stable and of uniform thickness and consistent quality.

THEORY metal

Metals

All metals in use today are either PURE METALS or ALLOYS. Copper, iron, tin, lead, gold and silver are all examples of PURE METALS which have been mined from the Earth and extracted from the ore using a process called SMELTING.

An ALLOY is a mixture of pure metals or a metal with a substance such as carbon added; examples of alloys are:- Steel (Iron & Carbon), Duralumin (Aluminium & Copper), Brass (Copper & Zinc) & Bronze (Copper & Tin).

Name	Composition	Properties	Uses
Cast Iron	Iron + 3.5% Carbon	Smooth, soft core, strong when compressed, cant be bent or forged.	Vices, lathe beds, garden bench ends and car brake drums.
Mild Steel	Iron + 0.15 - 0.35% Carbon	Ductile, malleable, tough, high tensile strength, corrodes easily. Easily welded.	Car bodies, machine bodies, nuts and bolts, screws, nails and girders.
High Carbon Steel (tool steel).	Iron + 0.8 - 1.5% Carbon	Very hard, rather brittle, difficult to cut, poor resistance to corro-sion.	Tool blades e.g. Saws, chisels, screwdrivers, centre punches and so on.
High Speed Steel	Iron + Tungsten, chromium vanadium.	Very hard, heat resistant, re-mains hard when red.	Drills, lathe cutting tools, milling cutters, power hacksaw blades and so on.
Stainless steel	Iron + chromium, nickel, magnesium.	Tough, hard, corrosion resistant, wears well, difficult to cut, bend and file.	Cutlery, sinks, teapots, kitchen ware, saucepans and so on.

Ferrous Metals

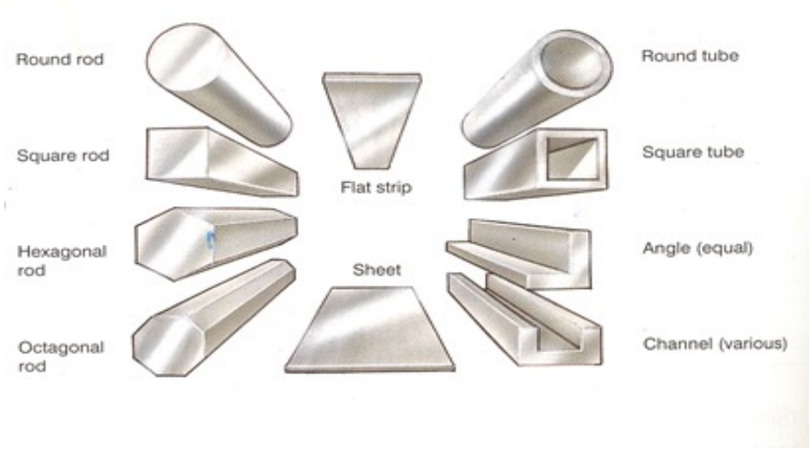
This category of metals contain iron and are usually magnetic; examples of such are Cast Iron, Mild Steel, High Carbon Steel, etc.

Non-Ferrous Metals

As the name implies (NON), this category of metal does not contain iron and is usually non-magnetic; examples are, Aluminium, Copper, Brass, Duralumin, Lead, Gold, Silver, etc.

Name	Composition	Properties	Uses
Aluminium	Pure Metal	Strong, light, malleable, ductile, difficult to weld, non-toxic, resists corrosion, conducts electricity and heat well and polishes well.	Kitchen foil, drinks cans and saucepans.
Duralumin	Alloy = Aluminium + Manganese, magnesium.	Stronger than pure aluminium and nearly as strong as mild steel but only one third the weight.	Greenhouses, window frames and aircraft bodies.
Copper	Pure Metal	Tough, ductile, malleable, conducts heat and electricity well, corrosion resistant, solder and polishes well.	Electrical wire, central heating pipes, circuit boards, saucepan bases.

Forms of supply



THEORY plastic

Plastics

The basic raw materials used in the manufacture of plastics are oil, natural gas and coal, but contrary to popular belief, plastics are not a new "space age" material. Natural plastics such as shellac, wax horn, pitch and bitumen have been known for thousands of years..Just as timber is classified as either a softwood or a hardwood and metal as either a ferrous or non-ferrous, so plastics are classified into two main groups; Thermoplastics and Thermosetting plastics.

Thermoplastics

Thermoplastics soften when heated, can then be shaped, and then harden as they cool. With this type of plastic the softening and hardening can be repeated many times over. When a thermoplastic has been re-heated it will return to it's original shape unless it has been permanently damaged by excessive heat or deformation. This characteristic of thermoplastics of re-heating is known as Plastic Memory (i.e. it remembers what its original shape was).

Used in schools

Plastic	Properties	Uses
Acrylic	Rigid, hard, can be clear, fluorescent, opaque, very durable outside and polishes to a high shine.	Illuminated signs, windows/glass, baths.
Nylon	Tough, self lubricating, resists wear, good chemical resistance	Gears, bearings, tights, clothing.
Polystyrene	Lightweight, hard, rigid, can be clear, good water resistance.	CD cases, packaging, model kits.
PVC	Rigid, quite hard, good chemical resistance, tough.	

Used in industry

Plastic	Properties	Uses
PET	Tough, clear and lightweight.	Bottles.
ABS	Very tough, scratch resistant, good chemical resistance.	Casings for electronic products, kettles, vacuum cleaners.

Thermosetting Plastics

As the name implies thermosetting plastics (or thermosets) set or solidify, when heated and cannot be returned to their original state by further heating.

Plastics are ideal for mass production of quality products, and can duplicate or better the properties of most other materials, including aluminium, glass, rubber and steel.

Properties
General properties of plastics include:
Light weight, Resistance to corrosion, Electrical resistant, Easily formed, recyclable

Used in schools

Plastic	Properties	Uses
Polyester Resin	Hard, rigid, brittle, tough when mixed with glass or carbon fibre.	Boats, car bodies.
Epoxy/ Resin	Strong, good, chemical and heat resistant, sticks to other materials as well.	Adhesive glue, covering electronic components such as microchips

Used in industry

Plastic	Properties	Uses
Melamine Formaldehyde	Rigid, scratch resistant, water and stain resistant.	Tableware laminates, top coatings on products.
Urea Formaldehyde	Rigid, hard, strong, heat resistant, does not bend when heated, good electrical insulator.	Electrical plugs, sockets, door knobs.

THEORY plastic

Acrylic

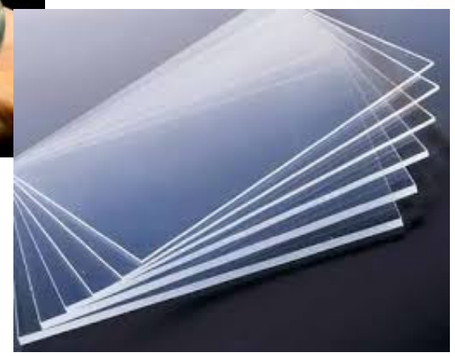
Acrylic materials are among the most commonly used thermoplastics in the school workshop and the material in which will most likely be used to manufacture any artefacts which are made. Often better known by it's trade name "Perspex", acrylic is available in clear or coloured sheets, rods and tubes. Acrylic is easily scratched and therefore sheets are usually covered on both sides by protective paper or thin polythene. As has been explained acrylic can come to the workshop in many various forms.

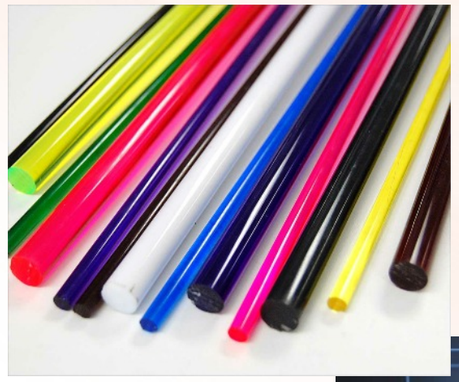
As has been stated acrylic sheet is supplied covered with paper or polythene film to prevent scratching of the finished surface. Whilst the paper covered sheets can be marked with a pencil the polythene covered sheets, and unprotected sheets are best marked with a felt- tipped pen.

Forms of supply

Plastics can be supplied in various forms:

- Profiled sheets, rods, tubes and bars
- Moulded compounds
- Thin layers of film and sheets
- Foam
- Casting compounds such as ingots
- Paint, varnish and lacquer for finishing
- Filaments and fibres
- Composites which contain reinforcing material

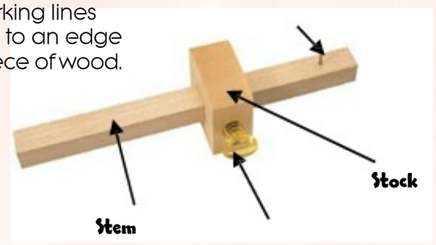




THEORY woodwork tools

Marking out Tools

For marking lines parallel to an edge of a piece of wood.



Marking Gauge

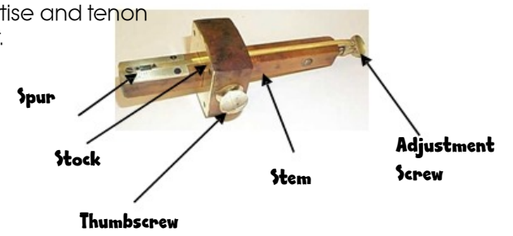
For marking lines at right angles to an edge of a piece of wood.

Steel Rule

For measuring sizes on wood, metal and plastic.

For marking out the width of a mortise and tenon joint.

Mortice Gauge



Cutting and Shaping Tools Saws and Sawing

It is important to note that there are two categories of Saw: Rip Saws and Cross-cut Saws. Rip Saws are used for cutting along the grain and Cross-cut saws are used for cutting across the grain.

The term Ker frefers to width of the cut that a saw blade makes.

Bench Hook/Sawing

Makes it easier to secure and saw small pieces of wood

Tenon Saw

Mainly used for cutting out joints in wood. - cause the blade is very id (stiff) due to brass back at the top of the saw. (Cross-Cut Saw)

Coping Saw

A thin saw used for making curved cuts. The blade can be set to almost any angle and is very flexible.

Panel Saw

Mainly used for making straight cuts in large pieces of timber. (Rip Saw)

Chisels

Chisels are used for chopping away waste wood when cutting a joint. Chisels The handle on a chisel is normally made from Ash which is a very strong hardwood or polycarbonate plastic so that it will offer resistance from splitting when being used. Chisels will always have some type of ferrule that helps stop the wood from splitting.

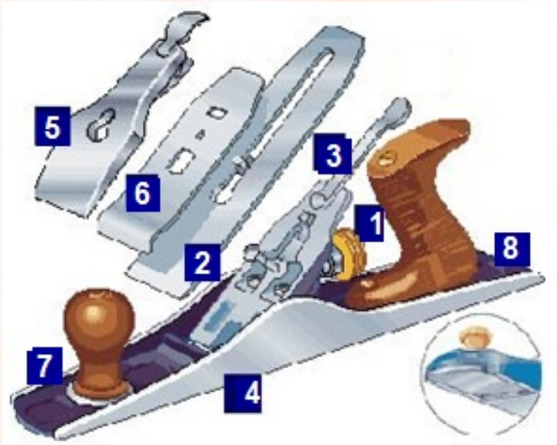
Bevel-Edged Chisel - The blade is sloped at the edges. This chisel is normally used for pairing wood or cleaning/tidying up joints.

Beech/Wooden Mallet
Used for driving a chisel through wood.

Mortise Chisels - Used for cutting the mortise (hole) in a mortise tenon joint. Note: that mortise chisels normally have a leather washer that helps to absorb the shock from hammering when driving the chisel through wood.

THEORY woodwork tools

Smoothing and Jack planes
Although both Jack and smoothing planes look similar they are used for different jobs: Jack planes are used to make long edges straight and square and are longer than smoothing planes. Smoothing Planes are used to make surfaces smooth.

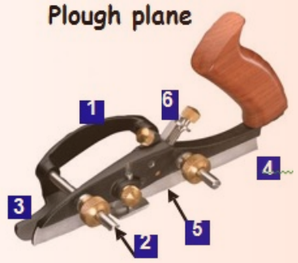


Plane Parts

1. Blade Depth adjustment Screw.
2. Blade
3. Blades lateral adjustment lever.
4. Sole
5. Lever Cap
6. Cap iron
7. Toe
8. Heel

1. Fence (For measuring how far in you want to cut).
2. Fence adjustment screw
3. Toe
4. Heel
5. Blade
6. Blade adjustment screw
7. Depth gauge

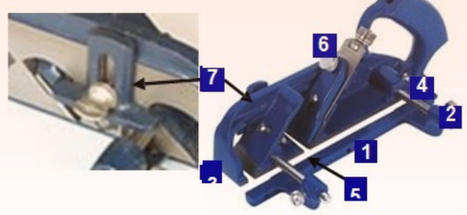
Plough plane



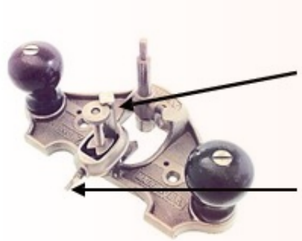
Used for cutting grooves on the inside of a face on a piece of wood.

Used for cutting grooves on an edge of a piece of wood.

Rebate

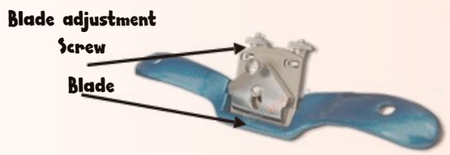


Router Plane



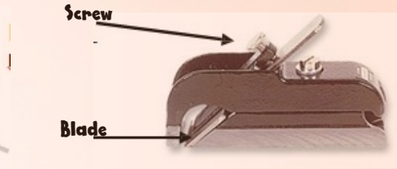
Small Router Plane (Granny's Tooth)

Bullnose Plane



Blade adjustment Screw

Bullnose Plane



Plane Safety

- Always ensure that the blade is set correctly to ensure that there no risk of accident or damage to your wood/plane.

- Always place your plane side up on the work bench too

2 THEORY metalwork tools

Marking out Tools

Scriber

For marking metal.

Centre Punch

For accurately punching holes before drilling.

Odd Leg Callipers

For marking straight lines parallel to the edge of a piece of metal.

Spring Dividers

For marking circles on a piece of metal.

Measuring Tools

Callipers

Outside:
For measuring outside widths and diameters on metal.

Inside:
For measuring inside widths and diameters on metal
Can also be used with wood and plastic

Micrometer

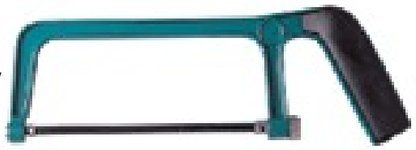
For very accurate measurement of outside diameters on metal or plastic

Cutting

Hacksaw

Used for cutting thick and large

Junior Hacksaw



Used for cutting small pieces of metal such as sheet metal and wire

Power Hacksaw

Band saw type machine used for heavy cutting of large pieces of metal such as round bar or square bar.

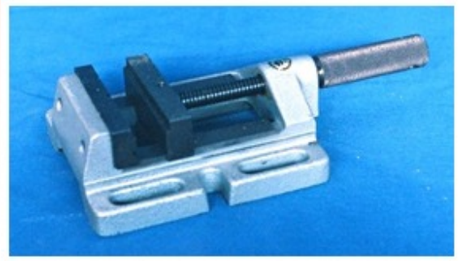
THEORY metalwork tools

Vernier Callipers
The vernier callipers are also used for measuring very accurate sizes except the vernier calliper can measure internal sizes, depths and external sizes

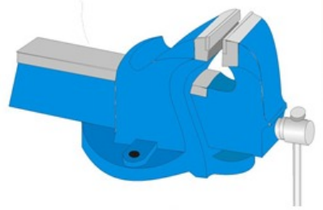
Folding Bars
The folding bar is used when folding sheet metal in order to obtain a straight, neat bend. They are usually held in a vice for small scale work.

Hand Vice
This is used for holding small and especially irregular shaped parts while drilling, riveting etc.

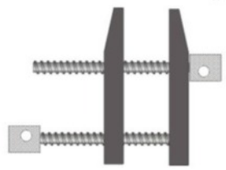
Machine Vice
This type of vice is used to hold heavier pieces of metal while drilling. The main body of the vice has been CAST in a mould. The handle of the vice has been KNURLED.



Engineer's Vice
The vice is bolted to the bench top so as to ensure the vice does not move while working on it. The vice is used primarily to hold metal while cutting, sawing, filing, etc. are carried out. As with the machine vice the body has also been CAST in two separate pieces.



Toolmaker's Clamp
These are used to hold parts together while marking out, shaping and drilling.



Hammers/Mallet

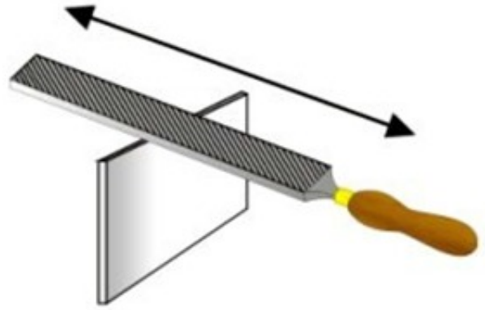
Raw Hide Mallet This mallet is used when it is important not to make any marks on the metal. Ball Pein Hammer This is a general use hammer although the ball pein end of the hammer is used specifically to round the heads of the snap head rivet.

2 THEORY metalwork tools

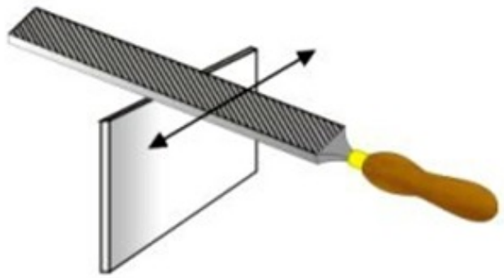
Filing

Files are used to shape metal. They are available in a number of different shapes and degrees of roughness.

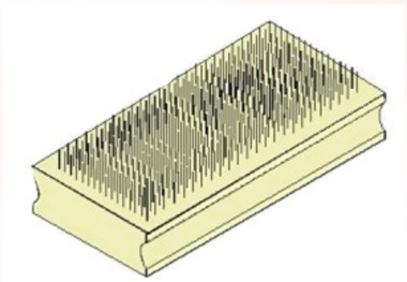
Files must not be used without a handle.



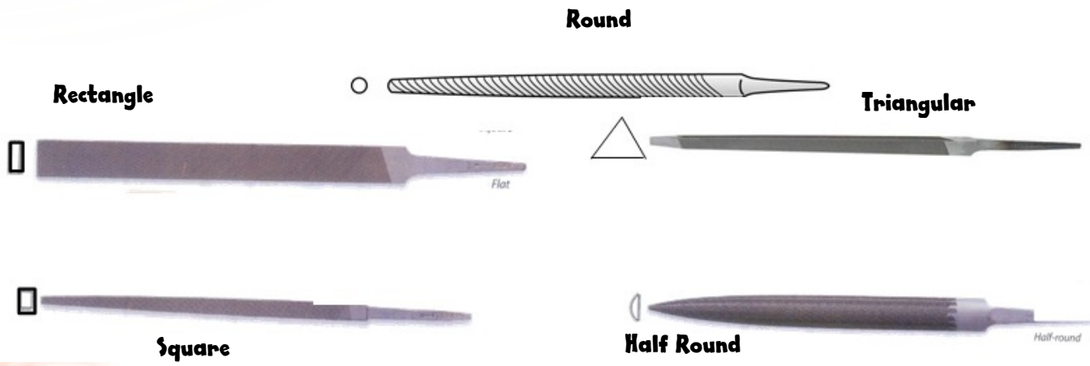
Cross filing
In this type of filing the file is moved across the work piece using the full length of the blade. This method of filing is used for removal of a lot of material with every stroke applied.



Draw filing
In this method of filing, the file is moved sideways along the work piece and is used to obtain a smooth finish after cross filing. This method does not remove much material.



Cleaning the file
Small pieces of aluminium or plastic can be trapped in between the teeth of the file. This is called PINNING. A FILE CARD can be used to clear the file of the excess material. The file card looks very similar to a wire brush except the teeth are very short.



Files
There are many different files that are used for filing metal to shape and filing rough edges smooth. Files also come in a range of sizes for different jobs.

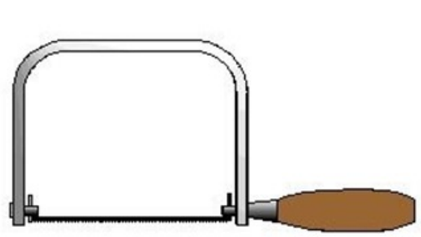
THEORY plastics tools

Plastics Tools

In the school workshop the most common method of cutting acrylic is by sawing. Fine toothed saws like the coping saw, hacksaw and junior hacksaw are the most suitable. Sawing must be done carefully and steadily to avoid chipping and splintering the material. The band saw can also be used but is only to be used by the teacher.

Hacksaw
The hacksaw is used for general cutting of metal bar, tubes, etc. The blade is easily removed by slackening or tightening of the front wing nut.

Junior Hacksaw
This type of saw is also used for cutting metal but is used for light work or where a hacksaw is too clumsy.



Coping Saw
The coping saw is used to cut curves and other awkward cuts in plastic or wood. It is also unique as it is one of only a few saws which has its teeth facing backwards. In normal sawing the cut is made in the forward stroke but with the coping saw the cut is made on the backward stroke.

Files are used to shape metal or plastic.
They are available in a number of different shapes and degrees of roughness. Files must not be used without a handle. See page 74

THEORY metalwork processes

Screw Threads

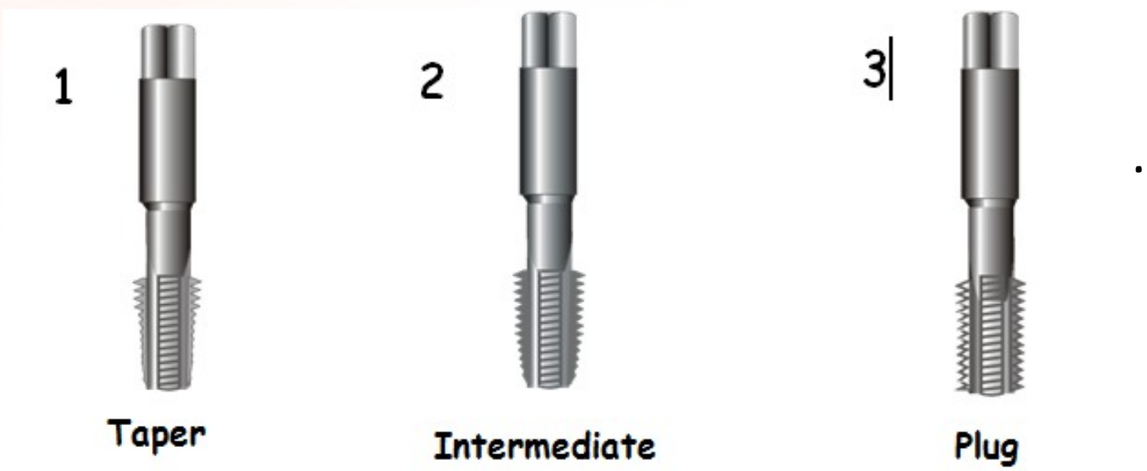
The screw thread is a very important detail in engineering. It is used to hold parts together. (e.g. bolt & nut) and to transmit power (e.g. vice screw).

Internal Screw Cutting

To achieve an internal screw thread, a hole has to be drilled first and then a tool called a TAP is used to cut a thread within the hole. TAPS are made from high speed steel (HSS). The top of the tap is square which enables the tap to be held securely in a TAP WRENCH, which can be seen below.

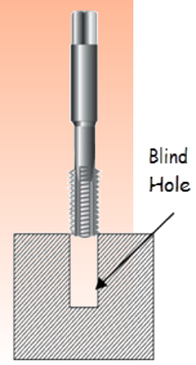
Taps are generally available in sets of three and are used in the following order:-

1. Taper Tap
2. Second Tap
3. Plug Tap



Blind Hole

A blind hole is a hole which has a bottom to it. If a blind hole is to be threaded it is very important to ensure that the depth of the hole is established before commencing to thread the hole. If this is not established it would be very easy to break the taps. A piece of tape attached to the tap indicating the depth is an ideal way of avoiding the tap from being broken by being forced into the bottom of the hole



THEORY metalwork processes

External Screw Cutting
To cut an external thread on a metal rod a tool called a DIE will be used.

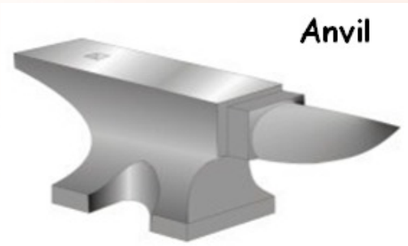
Circular Split Die

The picture opposite shows a split die, this is the most common type of die used in the school workshop. These are used for cutting external threads. The die is made from high speed steel (HSS). To assist in starting the thread cut, the split die has a split which enables the die to be opened slightly thus cutting a shallower cut.

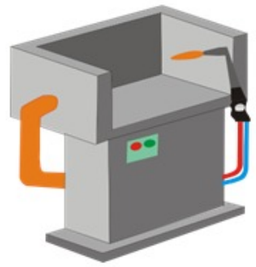
Die Holder or Stock
The circular split die fits into the die stock with the tapered side of the thread (shown by the writing on the die) The split in the die fits opposite the centre screw to allow the opening and closing of the die. The two screws at the side hold the die in the stock To ensure the die can start to create a thread on the rod the rod must firstly be tapered at the end.

Heat Treatment of metals

When a metal is cold worked, i.e. when it is cut, beaten, hammered, bent, twisted or shaped, etc. at normal room temperature, tremendous internal forces are set up within its grain structure and the metal becomes extremely hard and liable to split. The term 'heat treatment' is applied to metals that undergo some form of heating process in order to change their properties. Generally, any heating process carried out on a solid metal is referred to as heat treatment. Heat treatments involve processes such as annealing, normalising, forging, hardening, tempering, etc.



Malleability
This is the ability of a material to withstand being hammered, rolled or bent without the material breaking.
Ductility
This is the ability of a material to withstand being stretched without the material breaking
Toughness
This property of the material is the amount of energy it can absorb without breaking and measures its ability to withstand shocks. It is the opposite of brittleness.



THEORY metalwork processes

Work Hardened
If a material has been bent, hammered or twisted consistently over a period of time the metal will be Work Hardened. What is meant by this, is, the tiny molecules which make up the metal have been pushed and twisted out of their original positions thus making the metal very liable to breaking. This can be fixed by Annealing the metal.

Annealing
This process makes the metal as soft as possible to relieve the internal stresses, and make it easier to shape. The annealing process generally involves heating up to a certain temperature and allowing to cool, either in the air or in water depending on the material being annealed. If soap is applied to Aluminium prior to heating it will turn black when the correct temperature has been reached.

Tempering
This process involves heating the metal to various temperatures and then immediately quenching it in water. As the metal is being heated it changes colour starting with a pale straw to dark straw to reddish brown to purple then dark blue. Dependant on what properties are required of the steel being tempered will determines what heat it will be heated to. E.g. when it reaches a dark blue colour it is at 300^{O} C. These colours are known as TEMPERING COLOURS.

Case Hardening
Mild steel cannot be hardened and tempered as its carbon content is too low. What can be done is to provide it with a hard outer case. In this process the metal is heated to a bright red heat and then rolled in a carbon rich powder. The carbon is absorbed into the skin of the metal thus making it very hard on the outer skin. This type of metal is ideal for components such as gear wheels which require to be hard wearing

Hardening
To enable carbon steel (i.e. tool steel) to be used for the wide variety of tools and articles that are necessary in the school workshop and in industry it must first be hardened, then tempered.

Taking a high carbon screwdriver blade for example, this is HARDENED by heating it slowly to a dull cherry colour and then quenching it in oil or tepid water. When this part of the process has been carried out, it is unusable. Although it is very hard and brittle (i.e. it can break very easily). To make the hardened steel usable it must now be TEMPERED, i.e. given properties such as toughness, elasticity, strength.

Twisting

As can be seen from the sketch below, the metal bar is heated until red hot, it is then twisted to the desired shape

Drawing Down

This involves the heating and re-heating of the metal bar and hammering it until a desired point is achieved.

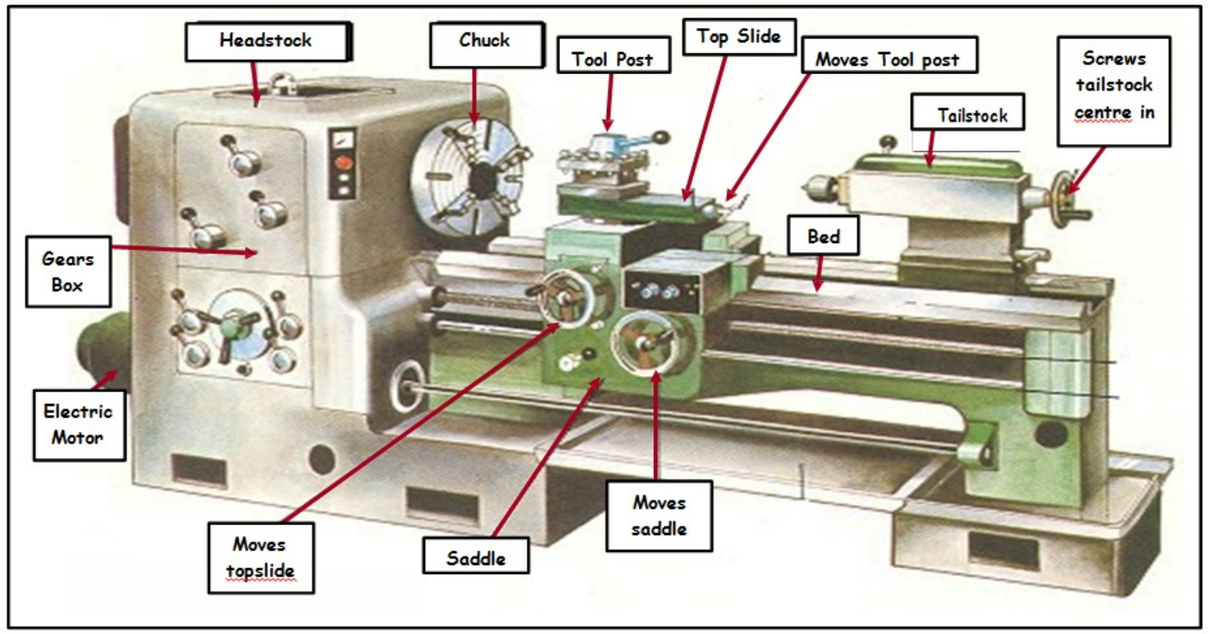
Flattening

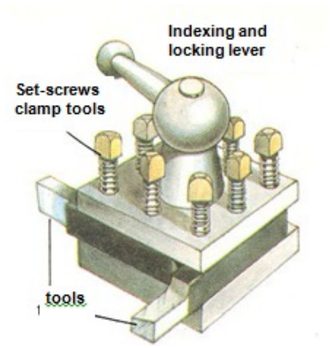
This involves the heating and re-heating of the metal bar and hammering it until the desired flatness is achieved.

THEORY metalwork processes

Metal turning

Metalwork Lathe/centre lathe

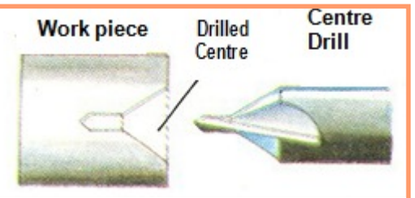




The tool post can be arranged to hold just one tool, or up to four. By loosening the screw-lever, the tool post can be rotated to each tool in turn.

Lathe Tools

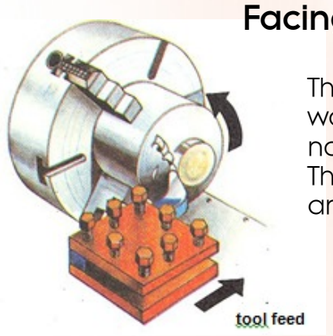
1. **Parting-Off.**
2. **Screw cutting.**
3. **Facing/parallel turning**
4. **Roughing**



Slocombe Drill/Centre Drill

This particular drill is used to drill a centre hole before you go ahead and drill the main hole. It is used with the tailstock

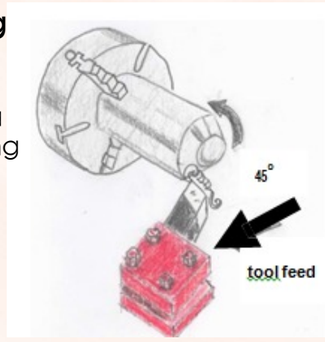
Facing off

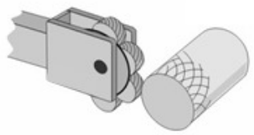


This means cutting across the end of a work piece. It is one of the first things normally done at the start of a new job. The process allows us to tidy up the face and ensure that it is flat

Chamfering

A chamfer is a slope on the edge of a piece of material. It is made by cutting at an angle on a job.



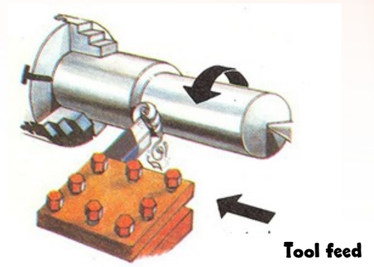


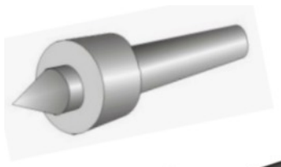
knurling

This process is used to engrave a diamond shape pattern onto the metal. This pattern acts as a grip for handles and screws.

Parallel Turning

This means cutting parallel to a job. The process allows you to turn the metal to





Revolving Centre

The revolving centre is secured in the tailstock. The bar to be turned is secured at one end by the chuck and held in place at the other end using the revolving centre. The revolving centre allows the bar to rotate freely allowing turning between centres.

Jacobs Chuck

This tool is placed in the tailstock of the centre lathe and is used to hold twist drills.

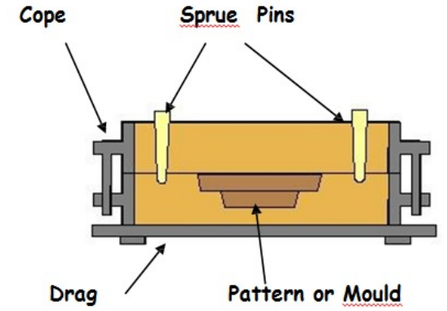
2 THEORY metalwork processes

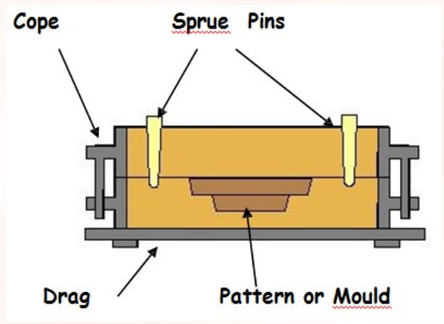
Sand Casting (Moulding)

Sand casting is the process of making metal shapes (components) using pre-shaped objects and sand. A typical example of an object which has been cast is the Engineers vice which can be found on the workbench. This tool will have been cast in two separate castings. The bottom part of the casting unit which is called a DRAG because of the fact that the PATTERN is dragged from the sand. The top half of the casting unit is called the COPE.

Stage 1

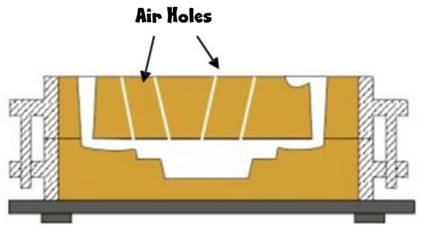
The COPE and DRAG are both filled with wet sand. The pattern (mould) is then pressed into the sand until flush with the surface. As can be seen from the drawing the cope is then placed on top of the drag. Sprue pins are then pushed through the sand to produce a RUNNER and a RISER. The runner will be the channel in which the molten metal will be poured into the mould.





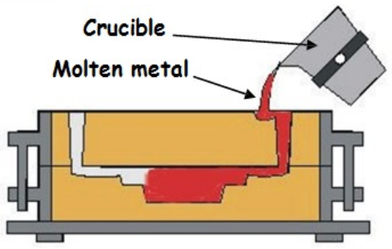
Stage 2

At this stage the wooden pattern has been removed and the riser and runner which were created by the sprue pins have been extended into the space left by the pattern. This will allow molten metal to flow through into the mould.



Stage 3

This shows a cross section (cut through the middle) of the pattern and runners. Very narrow holes can be seen, this allows excess gas and moisture to escape thus allowing the metal to fill fully all available space in the pattern

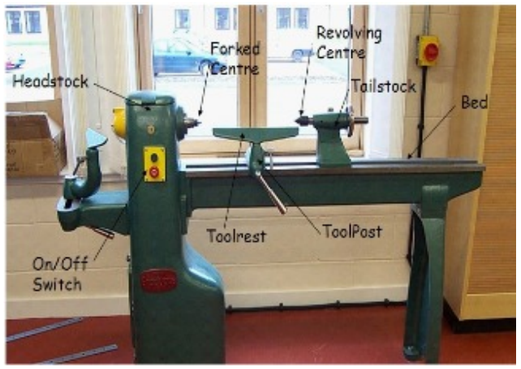


Stage 4

The final stage in the process is to pour the molten metal into the runner. The air which occupies the pattern space is forced out of the riser on the other side. The finished mould is then removed from the sand. The mould will also have extensions attached at this stage in the form of a runner and riser. These will simply be cut off and recycled.

THEORY woodwork processes

Mortise Machine
A mortise machine appears to drill a square hole in wood. The machine actually drills a round hole but because the drill bit is surrounded by a hollow square chisel, while the drill is creating the hole, the chisel is cutting the edges away from the hole leaving the mortise (square hole).



Turning Lathe
The wood lathe is a machine used to create cylindrical objects in wood, i.e. wooden bowls, table legs, etc. A piece of wood is secured between two points called the HEADSTOCK and the TAILSTOCK. The headstock has a motor enclosed and s therefore the end which actually turns the wood.
The surface finish of the wood being turned can be improved by increasing the speed of the lathe

Wood turning tools are used to shape the work piece. Depending on what shape is required will ultimately determine what type of tool will be used. The TOOL REST can be seen on the drawing on the previous page, this is used to support the tools while shaping is being carried out.

Revolving Centre - The Revolving Centre has bearings encompassed within the body of the tool. This allows the work piece to revolve without friction.

Dead Centre - The tailstock remains stationary while the work rotates. This causes friction and therefore the work piece has to be greased.

Centre Fork - The centre fork is secured in the revolving spindle (headstock). The fork is driven into the wood to be turned, the fork then turns the wood.

Face Plates - Face plates are secured to the headstock of the lathe and are used to hold blank pieces of wood which can then be turned into wooden bowls.

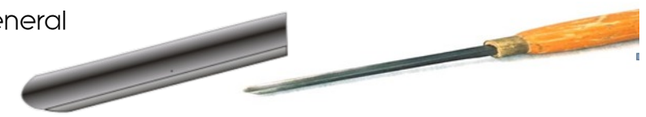
THEORY woodwork processes

Wood turning

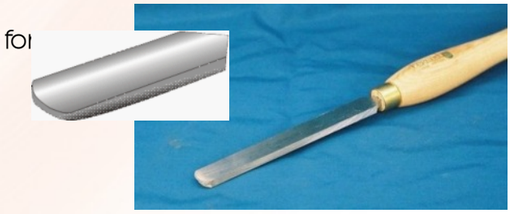
Wood Turning Tools

Parting Tool - The parting tool as its name implies is used to part off the "turned wood" from the Remaining wood at either end.

Spindle Gouge - This round nosed gouge takes over from the roughing-out gouge for general between- centres turning.



Round Scraper - These scrapers are used for working inside bowls and goblets.



Skew Chisel
This chisel is used to give a good surface finish Stages in preparing a piece of wood for turning Stages in preparing a piece of wood for turning

Stage 1

On both ends of wood mark a line from corner to corner to establish the centre.

Stage 2

On one end of the wood, using a centre punch, make a hole. The Cone Centre will locate here

Stage 3

On the other end cut a Kerf. The Centre Fork will locate here.

Stage 4

Now plane all four corners of the wood as can be seen from the sketch above.

THEORY plastic processes

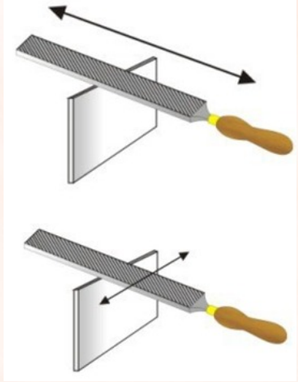
Plastics Processes

Stages in finishing an edge of acrylic

When acrylic plastics are cut they tend to have very rough edges, this is due to the fact that it is a very brittle material. Brittle means that although it is very hard, it tends to break easily especially when sawing. To ensure the plastic is finished with a clean smooth edge it is essential that the edges are finished in the following sequence.

1 Cross file the edges to remove the majority of blemishes.
2 Draw file the edges to remove the marks left from cross filing.
3 Use wet and dry paper to get an overall smooth finish.
4 Use acrylic or metal polish (Brasso) to achieve the final finish.

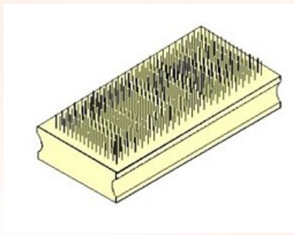
Always finish the edges of the acrylic prior to any bending. Cross filing



In this type of filing the file is moved across the work piece using the full length of the blade. This method of filing is used for removal of a lot of material with every stroke applied.

Draw filing

In this method of filing, the file is moved sideways along the work piece and is used to obtain a smooth finish after cross filing. This method does not remove much material.



Cleaning the files

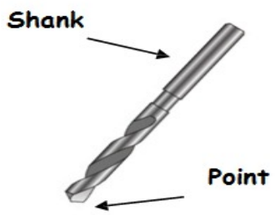
Small pieces of plastic can get trapped in between the teeth of the file. This is called PINNING. A FILE CARD can be used to clear the file of the excess material. The file card looks very similar to a wire brush except the teeth are very short.

Drilling Holes

Holes can be drilled or cut in acrylic using standard drilling equipment, twist drills or hole saws. Prior to drilling it is very important to ensure the bottom of the acrylic is supported with a piece of wood. If it is not the most likely result will be the cracking of the acrylic. It is also essential that you drill into the acrylic slowly.

Twist Drill

Twist drills are generally made from a carbon steel and are used for drilling circular holes in metal, plastic or wood. Twist drills have three basic parts, a point, a parallel body and a shank which can be either parallel or tapered.



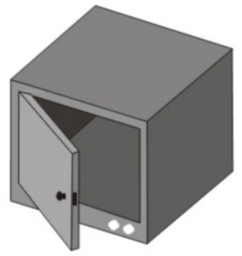
Hole Saw

This tool is used to drill big holes in wood or plastic and is generally fitted to an electric drill. The hole saw has a centre drill attached which is called the PILOT drill. It is called the pilot drill as it pilots the larger diameter cutter to exactly the right location.

THEORY plastic processes

Bending and Forming Plastic

Acrylic becomes soft and pliable when heated to approximately 150 ºC. In this state it can be easily bent and formed to shape. On cooling to room temperature the formed shape is retained. The most convenient method of heating, prior to bending and forming, is to use the oven or strip heater.

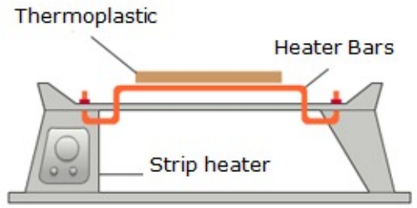


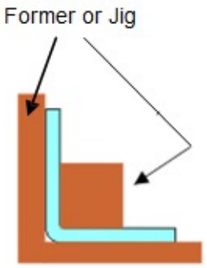
The Oven

Where more complex shaping of acrylic is required it is necessary to use an oven for heating. For a 3mm thick sheet of acrylic the oven should be set to a maximum temperature of 170˚C and the sheet heated for about 15 - 20 minutes before forming to the required shape.

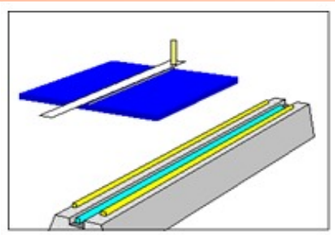
The Strip Heater

The purpose of the strip heater is to heat only a narrow strip of acrylic to allow local bending. Before bending the acrylic the protective coating is removed and then area to be bent is marked with a pen. After heating it sufficiently the acrylic can be shaped, preferably using a suitable former or jig.

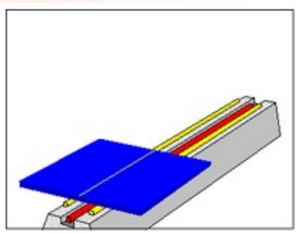




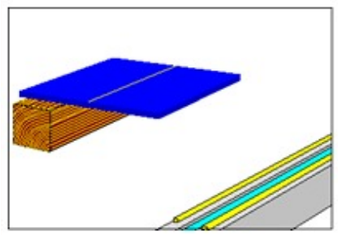
Stage 1
The first stage is to mark the line where the bending will take place



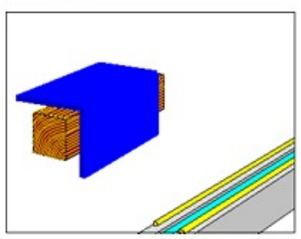
Stage 2
The second stage is to place the acrylic over the heating element, turning regularly to avoid burning.



Stage 3
The third stage is to remove the soft heated acrylic and place it on a suitable JIG or FORMER



Stage 4
The last stage is to bend the acrylic to the desired shape.

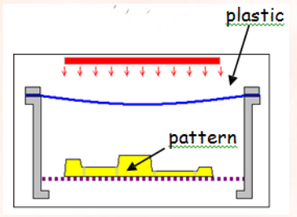


THEORY plastic processes

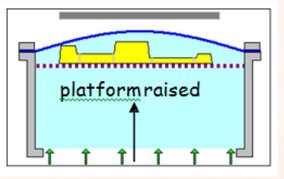
Vacuum Forming

In Vacuum Forming, a sheet of thermoplastic is held in a clamp and is heated until it is soft and flexible. Air is sucked out from Underneath the sheet so that air pressure pulls the sheet down onto a specially made mould. This process enables thermoplastics to be formed into complicated shapes such as packaging, storage trays and seed trays.

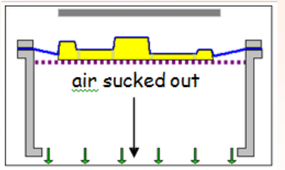
Stage 1
The first stage of vacuum forming is to clamp the sheet across the top of the machine and heat it until the plastic is soft and flexible. This can be judged by watching the material, which will start to sag under its own weight when soft. If touched with a stick it will feel soft and rubbery.



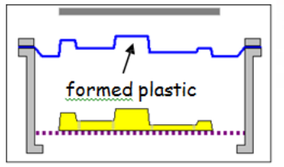
Stage 2
The pattern is then raised up to meet the hot soft plastic.



Stage 3
At this stage the air has been sucked out from beneath the plastic pulling it onto the pattern.



Stage 4
The final stage is to remove the pattern from the plastic leaving the finished article.



The pattern tends to have sloping sides to allow it be removed from the cooled plastic easily. Also, the corners are rounded to prevent the plastic from tearing.

http://www.youtube.com/watch?v=1t39xX6fjt0

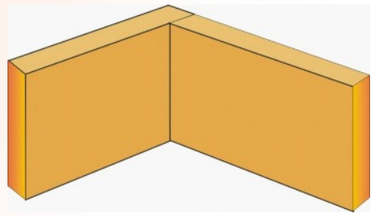
THEORY joining materials - wood

Wood joints

The majority of joints used in woodcraft have been designed specifically to attain the maximum possible strength in the model they are holding together. The type of joint selected will depend on what is being constructed i.e. what forces are going to be exerted upon the artefact. The selection is also dictated by the final appearance. i.e. in furniture manufacture it is normally important to hide the joint as a piece of furniture which has a joint construction which is strong but showing will not be very pleasing to look at and ultimately potential customers would most likely avoid buying such furniture.

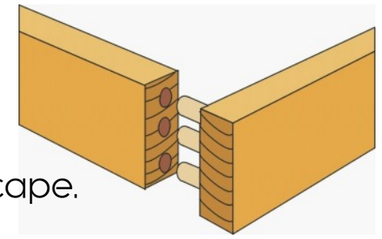
Butt Joint

Butt joints are the quickest and simplest to make but are not very strong. They generally need dovetail nailing to increase the overall strength of the joint.



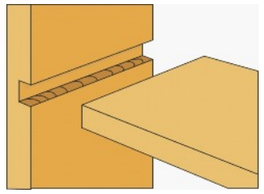
Dowelled Joint

These joints are both neat and strong. The holes must be lined up exactly but this can be done using a dowelling jig. The dowel will have a groove in the length so as to allow excess glue to escape.



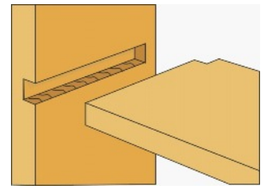
Through Housing

These joints are simple to make and are suit able where the two parts being joined together are the same width.



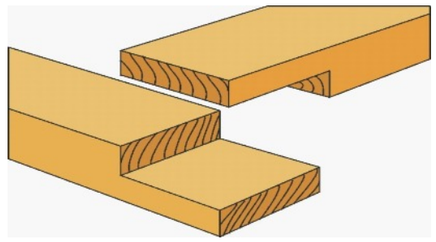
Stopped Housing

These are harder to make, but are neater because the joint does not show on the front edge.



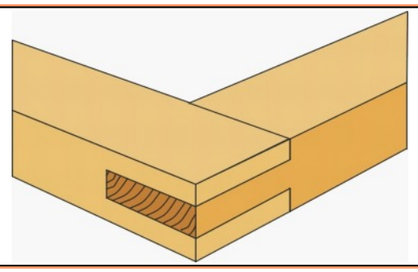
Corner Halving Joint

This joint is stronger than the butt joint and is also simple to make, but still needs strengthening with screws or



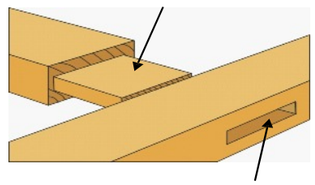
Corner Bridle

This joint is strong and fairly easy to make. They can be strengthened by dowels.



Mortise & Tenon Joint

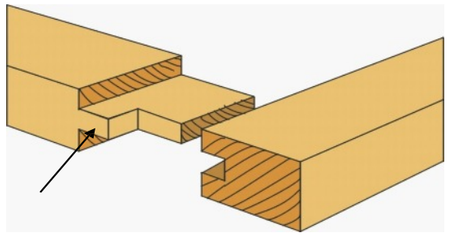
The mortise & tenon joint is the strongest tee joint and can be further strengthened by wedging or dowelling.



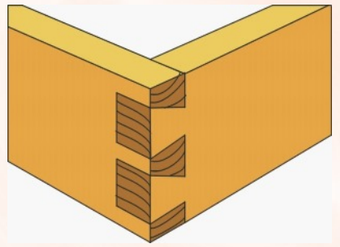
THEORY joining materials - wood

Wood joints

Haunched Mortise & Tenon Joint
This joint is used where the rail of a table oin into the top leg of the table. This could be regarded as a hidden joint.



Dovetail Joint
This type of joint is very strong and can be only pulled apart in one direction. It is used to construct drawers.



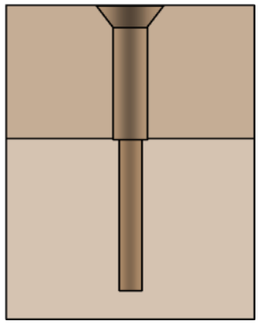
Wood Adhesives

PVA - Polyvinyl acetate is a component of a widely used glue type, commonly referred to as wood glue, white glue, carpenter's glue, school glue, Elmer's glue (in the US), or PVA glue.

Polyurethane glue (trade names include Gorilla Glue and Excel) bonds to textile fibers, metals, plastics, glass, sand, ceramics, and rubber, in addition to wood. Polyurethane wood adhesives work through a reaction with water which cures the adhesive.

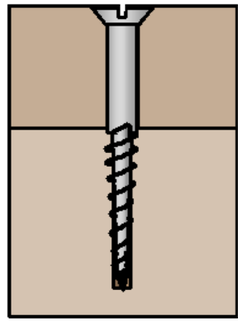
Screws & nails

Countersink to get Screw flush with top

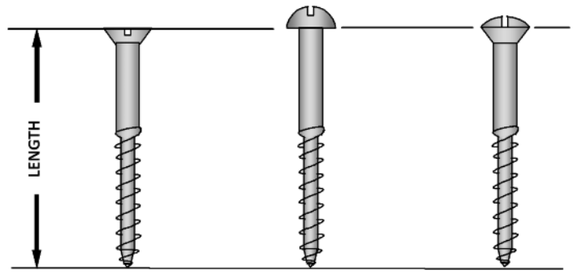


Clearance hole:
Drill to diameter of Shank

Pilot hole:
Drill to diameter of root thread



Screw



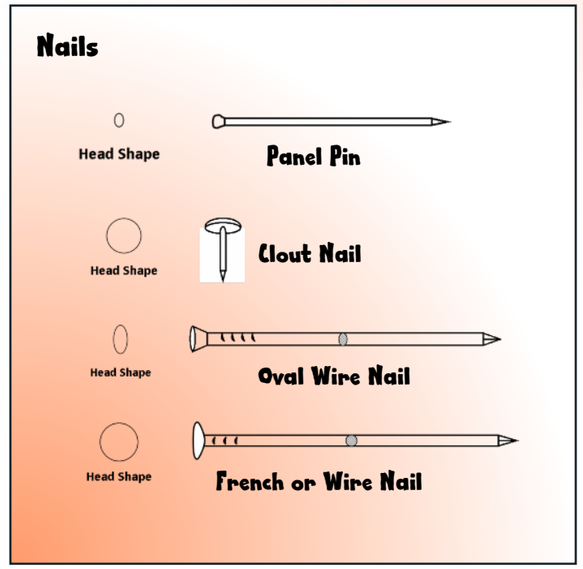
Counter-sunk Head

Round Head

Raised Head

Slot Screw

Pozidriv® Screw



THEORY joining materials - metals

Metals - Riveting

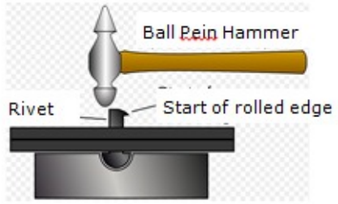
Rivet Set and Snap

The set hole

The snap hollow

This tool allows us to en- sure that the metal being joined and the rivet are all held together firmly. A ball pein hammer is then used to flatten the rivet and secure it

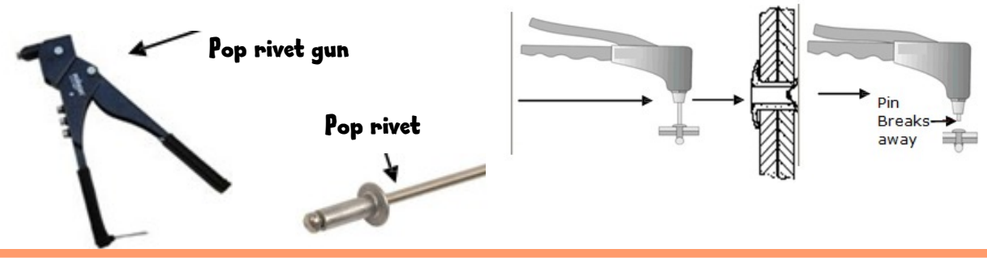
Types of Rivet



Ball Pein Hammer
Used for general metalwork where a hammer is required.

Pop Riveting

When Pop Riveting the rivet is placed in the holes of the metal being joined. The Rivet gun is then placed over the rivet and the handles squeezed together. As you apply more pressure the rivet expands in the hole until the pin eventually breaks away.

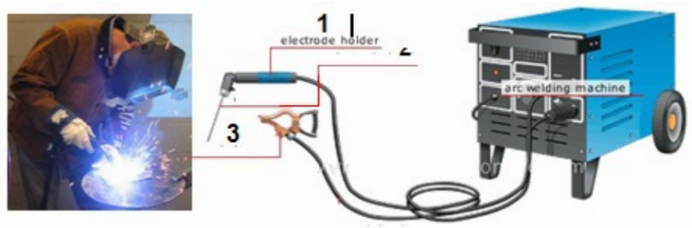


Welding

Spot/Resistance Welding Used for joining thin sheet metal. An electric current is passed through the copper rods and the metal being Joined, which causes heat to build up and melt the metal

Arc Welding

Used for joining thick metals including bar form and round form. Basically a metal filler is pushed through the electrode holder using gas. As this is happening electricity is used to produce heat which melts the metal being joined. The metal filler then fills gap to create a solid weld together.

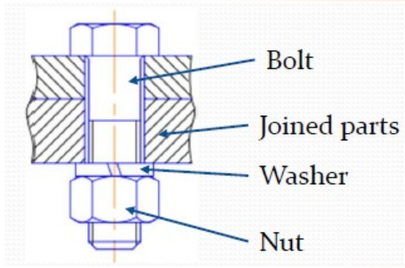


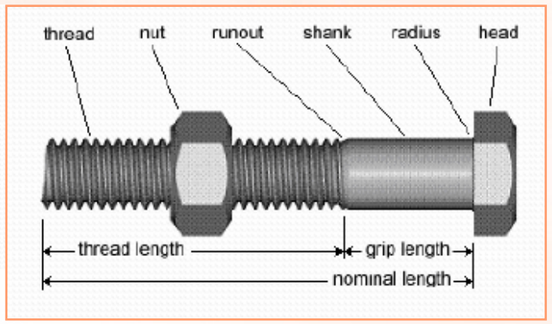
THEORY joining materials - metals

Soldering
Used for joining thin sheet metal and thin bar. A solder bolt is heated in the forge. Once hot enough it is used to melt a filler metal along the joint of the metal parts being joined.

Brazing
Used for joining sheet metal and thin metal bar/ rod. A gas air torch such as those seen at the forge, is used to melt the metal filler along the joint where the metal is being joined.

Nuts and Bolts
A nut and bolt is a non permanent fixing and therefore is suitable for jobs where parts need to be free to come apart. Bolts are available in different diameters, from M2 (2mm diameter) up to M40 and beyond. When used to secure 2 pieces of metal, a washer should be positioned between the nut and the piece of metal. There are 2 reasons for doing this: To distribute the pressure of the nut or bolt evenly over the part being secured, reducing the chance of damage thereto, and to provide a smooth surface for the nut or bolt to bear on, making it less likely to loosen as a result of an uneven fastening surface.





Adhesives
Steel epoxy: A two-part compound sold in tubes, steel epoxy is quite similar to regular epoxy. It forms a very strong, durable, heat-and water-resistant bond and is recommended for patching gutters and gas tanks, sealing pipes, and filling rust holes. Drying time is about 12 hours; curing time is one to two days.

Steel putty: This metal putty consists of two putty-consistency parts that are kneaded together before use. It forms a strong, water-resistant bond and is recommended for patching and sealing pipes that aren't under pressure. It can also be used for ceramic and masonry. Curing time is about 30 minutes; when dry, it can be sanded or painted.

Plastic metal cement: Plastic metal is one-part adhesive and filler. It is moisture resistant but cannot withstand temperature extremes. This type of adhesive is recommended for use on metal, glass, concrete, and wood, where strength is not required. Curing time is about four hours; when dry, plastic metal cement can be sanded or painted.

THEORY joining materials - plastics

Plastics - Adhesives

Adhesives, or glues, are designed to bond material together. As there are many different types of material to be bonded, a wide range of adhesives have been developed. The strength of a glued joint depends on three things: the area to be bonded; the strength of the glue when set; and the bond between the material and the glue. To achieve a strong glued joint the area to be glued should be as large as possible, the correct glue should be used and the surfaces to be glued should be as clean as possible.

Here are some adhesives commonly used with plastics:

Epoxy resin (Araldite) – comprises two parts, a resin and a hardener. They are mixed in equal amounts and can be used on most materials.

Acrylic cement (Tensol) – thick clear liquid with unpleasant fumes, specially made for acrylic.

Contact adhesive – thick brown rubbery glue commonly used to stick down plastic laminates when brought together the surfaces cannot be moved for adjustment.

Super glue – bonds on contact and is used on small surface areas.

THEORY joining materials - clamping

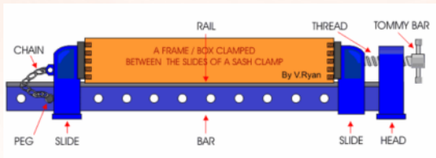
Clamping your work

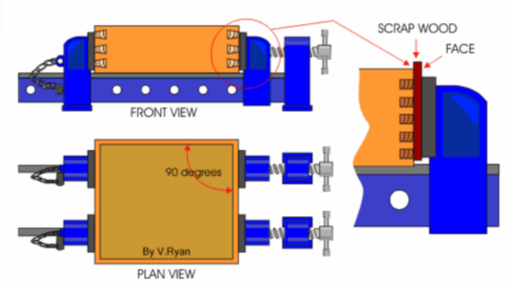
G-Clamps

G-clamps are used to hold pieces of wood together, most often when gluing. The screw section is tightened and the wood is sandwiched between the two flat pads with great pressure. Care must be taken when clamping as some woods can be soft and become marked permanently with the pressure of the pads, this can be stopped be putting a larger piece of scrap wood between the clamp and your job. They are named G-clamps because the shape of the clamp looks like the upper case letter "G".

Sash Cramps

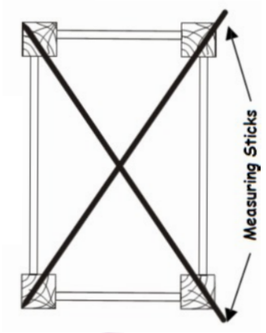
Sash Cramps are also used for holding pieces of wood together, usually whilst gluing. They are used for bigger jobs due to the long. They are normally used in pairs to hold together wooden frames or carcasses. They work similarly to the G-clamps as they also sandwich the wood between it's flat pads however the size of the cramp can be changed by sliding the back pad back and forth until then locked into place, before tightening up the screw at the other end.

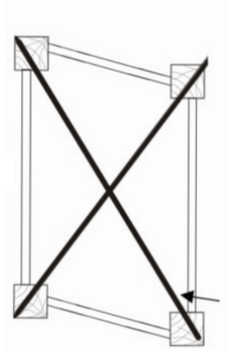




Gluing up Frames

Before any gluing of frames can be carried out, the frame must be assembled DRY. i.e. it needs to be checked to ensure that it is Square and is not affected by Winding (Twisting of the frame). To check if the frame is square it is ideally done using long straight sticks to check the diagonals.





As can be seen from the drawing opposite, if a frame construction is Square, the diagonal distance (Corner to Corner) between each corner will be the same distance. If the frame is not square the diagonal distance from corner to corner will be greater for one of the corners as shown opposite. This is corrected simply by adjusting the sash cramps until a satisfactory square - ness is achieved.

Diagonal much longer than opposite diagonal

2 THEORY machine tools

Machine Tools

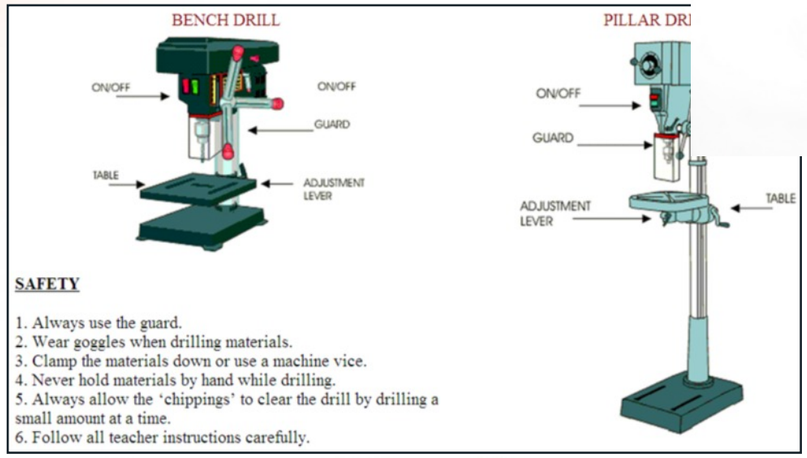
Belt Sander - You will see these in the school's workshops. They sand wood in a vertical motion.

Disc Sander – These sand in a rotational motion

Hand held Orbital Sanders – these come in many shapes and sizes. Each have a dust extractor attached to them to stop the use breathing in exes dust. They sand by moving the sanding beds in small circular motions (orbital motions).

Machine Tools - Drills

Cordless Drill This does the same as the bench and pillar drill, but because it is not attached to anything it can drill holes in more awkward areas. This can also be used as an electric screwdriver if the drill bit is changed for a screw bit.



SAFETY

1. Always use the guard.
2. Wear goggles when drilling materials.
3. Clamp the materials down or use a machine vice.
4. Never hold materials by hand while drilling.
5. Always allow the 'chippings' to clear the drill by drilling a small amount at a time.
6. Follow all teacher instructions carefully.

A mortise machine can be used to help cut out the mortise in a mortise and tennon joint. It uses a square chisel that contains a special twist drill to extract the waste wood.

Drill Bits

Twist Drill
Used for drilling holes. A normal drill set will include sizes from 1mm to 14mm.

Forstner Bit
Used for larger diameter holes. When using this bit the hole is drilled very slowly so that the bit does not 'jam' in the wood.

Hole Saw
For large diameters a 'hole saw' can be used. The advantage of this type of drill bit is that the blade can be changed to give different sizes of diameter.

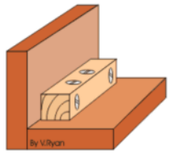
THEORY Knock down fittings

Knock Down Fittings

CAM LOCK FITTINGS The disk fits into a recess in the first side of the cabinet. It rotates by inserting a screwdriver into lot in its side. The shaft is screwed into the second side of the cabinet. The collar of the shaft is passed through the hole in the second slot in the disk. When the disk rotates the shaft is locked in position. This keeps both sides of the cabinet locked together.

SCAN FITTINGS These are strong enough to be either permanent or temporary joints. The cylinder is inserted into the first side of a cabinet in a pre-drilled hole. The screw is then pushed through the hole in the second side until it meets the cylinder. It can then be tightened with a screw driver until both sides of the cabinet pull together.

PLASTIC CORNER BLOCK (FIXIT BLOCKS) The corner block is pressed against the two pieces of material (normally wood based). Screws are used to fix the block into position. This type of joint is used to fit modern cabinets such as those found in a kitchen. It is a relatively strong joint although it has the advantage that it can be dismantled using a screwdriver.



NATURAL WOOD FITTING (SQUARE SECTION BATTEN) A piece of material such as pine can be drilled and screws can be passed through these holes. This gives a cheap and effective knock-down joint. The screws are normally countersunk into the knock-down fitting.

TWO BLOCK FITTING (LOK-JOINTS) These are made from plastic. A bolt passes through the first fitting into the thread of the second. As the bolt is tightened it draws the two fittings together. The pins help keep the fitting straight. This gives a very strong joint and it can be dismantled using a screwdriver.

RIGID JOINT These are normally moulded in plastic which makes them strong.
Screws pass through the four holes which hold the sides at each corner firmly together

THEORY manufacturing in industry

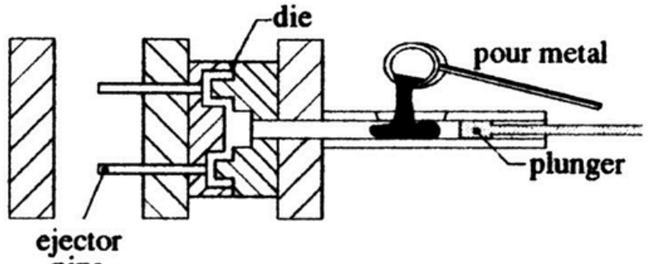
Metal)Die Casting (Moulding)

Where large numbers of identical components are required, sand casting is not appropriate because the mould has be broken up each time. Die casting is a method using a permanent mould (called a die). The moulds are made of tough alloy steel and are split into two or more parts to allow the casting to be removed.

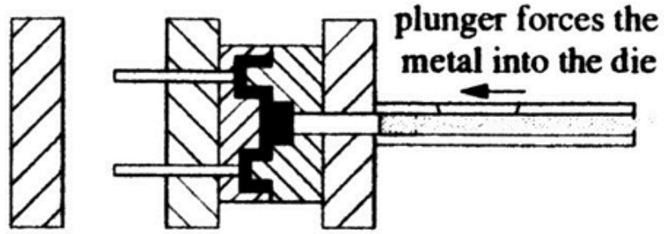
The holes to allow the molten metal into the die (the sprues) are normally too small for metal to fall through under gravity. A ram system is normally used to force the metal in under pressure, so the system is often known as Pressure Die Casting

This method is normally automated and can produce over 100 castings per hour.

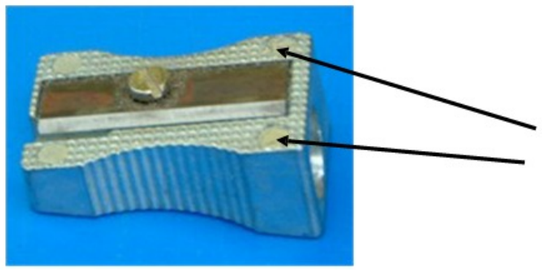
Stage 1
A measure of molten metal is poured into the charge chamber.



Stage 2
An injection piston, or plunger, then forces the metal into a water-cooled die through a system of sprues and runners.



Stage 3
The metal solidifies rapidly and the casting is removed, complete with its sprues and runners.



This pencil sharpener has been 'die cast'. It has ejector pin marks on each corner.

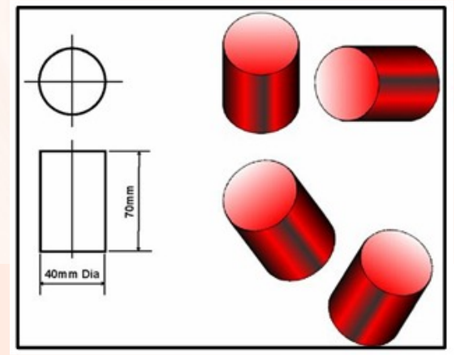
http://www.youtube.com/watch?v=LH8B3i6e8d4

THEORY manufacturing in industry

CAD/CAM

CAD/CAM stands for Computer Aided Design / Computer Aided Manufacture. This is the process whereby the product is designed using a computer, and the machines used to make it are controlled by a computer. Drawings and instructions written on pieces of paper are not required.

Computer Aided Design
Computer programs can be used to draw accurate, scaled drawings of the design of a product in both 2D and 3D. In 2D, dimensions can be added automatically and drawings of parts that are used a lot, such as nuts & bolts can be inserted like clip-art, from a drawings bank. In 3D, rendering (colour & texture) can be added as well as highlighting and shading. The view can be made to twist and turn so that it can be viewed from any angle. In industry, powerful programs can be made to animate moving parts and to work out the forces that the part will have to stand up to, so that it does not break in use. This can save hours of testing prototypes.



Advantages
Faster accurate drawing
Drawings of common parts can be inserted from a drawings bank, or library
Changes can be made quickly and easily
Dimensions can be added automatically
Printouts can be to any scale. In 3D, the object can be viewed from any angle

Disadvantages
The cost of the computer and pro- grams
Early ideas are recorded faster by sketching
A pad of paper and a pencil can be used anywhere

Computer Aided Manufacture
Computers can control cutting machines such as drilling machines, lathes, milling machines etc. The computer controls the movement of the cutter very accurately (accuracy to 500th of a millimetre is possible). In the CAD/CAM system, data from the CAD drawing is downloaded to the CAM program which is then used to control the cutting machine. A computer can also be used to control the handling of the parts to be cut from one machine to another. Computer controlled fabrication (joining parts together) is also possible. Parts can be automatically held together in the right positions, while they are welded, riveted or glued by computer controlled equipment. Injection moulding and vacuum forming can be done by computer controlled machines.

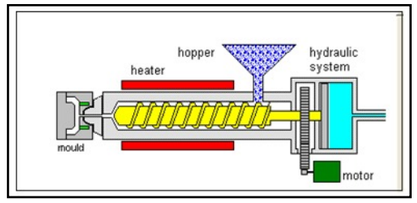
Advantages
- Very accurate work
- The machine does not need breaks
- The machine does not get tired and inaccurate
- Changes of design can be made quickly

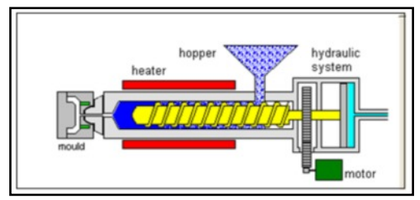
Disadvantages
The cost of the computers and programs
The high cost of the machines
The loss of jobs

2 THEORY manufacturing in industry

Plastics - Injection Moulding

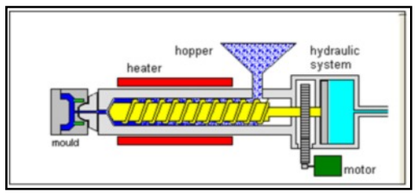
The process of injection moulding injects hot soft plastic through an injector into a mould rather than into long shaped strips. It is a process which allows large quantities of plastic components to be made quickly. Thermoplastic granules are heated until they soften. Then the material is forced under pressure into a mould. When cooled, the mould is opened and a component, which is the exact shape of the cavity is taken out. Injection Moulding is one of the most important industrial processes in the mass production of plastic goods. The cost of producing the moulds can be very high, therefore it is necessary to manufacture and sell large quantities of the product being manufactured to recover costs.

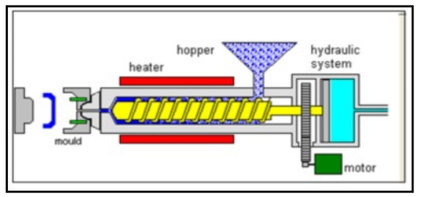




Stage 1
The first stage in the process is to place plastic granules into the HOPPER. The granules are then carried along the auger towards the injector.

Stage 2
As the granules are pushed along the auger they are heated at the same time making them into a hot soft plastic paste



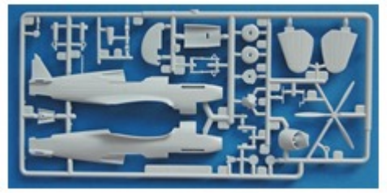


Stage 3
The hot soft plastic paste is then pushed out the end through an injector into the mould.

Stage 4
As the plastic paste is pushed out the injector into a mould/pattern it is held here for a short time while it cools. It is then ejected. Examples of articles which are injection moulded are mobile phone covers, buckets etc.

http://www.youtube.com/watch?v=WHwTHarf8Ck

Uses
Components produced by injection moulding vary from golf tees, spoons, wash basins, buckets, airfix models to product casings

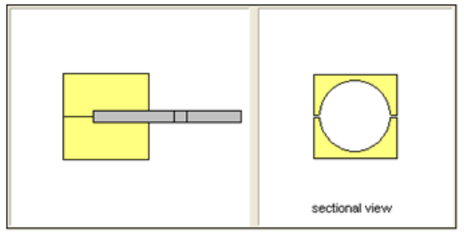


Identifying Features
A way of telling if a product has been injection moulded is to look for ejection pin marks on the surface of the product. These are normally circular marks left when the pins force the product out of the mould

THEORY manufacturing in industry

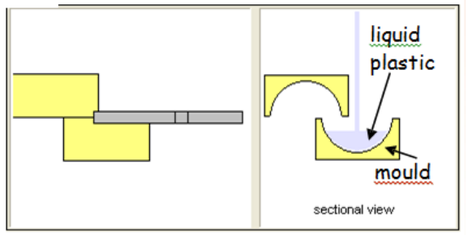
Rotational Moulding

This plastic process is used to create objects such as balls.



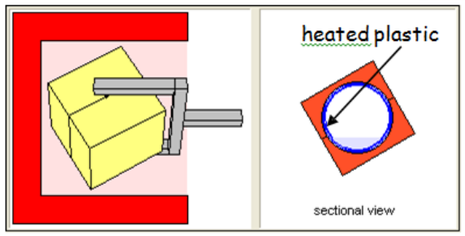
the rotational mould.

Stage 1
At this stage the liquid plastic is poured into the mould. The mould is then sealed and the process of rotating it begins.

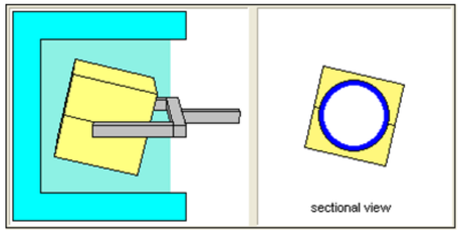


http://www.youtube.com/watch?v=VPLaUzMh3Rw

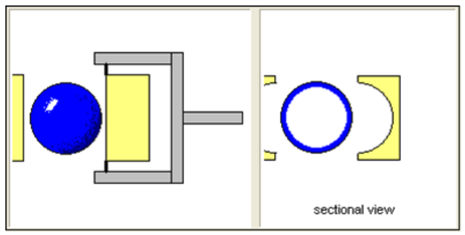
Stage 2
This stage shows the plastic being heated as it is rotated around the mould. The heated plastic coats the inside wall of the mould.



Stage 3
The completed plastic mould is now cooled before ejection from the mould.



Stage 4
The moulded shape is ejected from the mould. The picture here shows a hollow sphere.



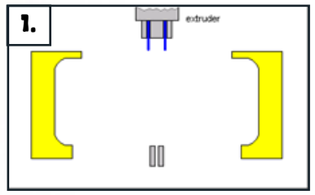
http://www.youtube.com/watch?v=CcGSKJxLfj8

THEORY manufacturing in industry

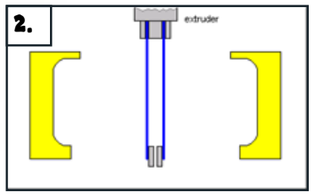
Blow Moulding

Extrusion blow moulding is an automated process that is used extensively to make bottles and other lightweight, hollow parts from Thermoplastic materials.

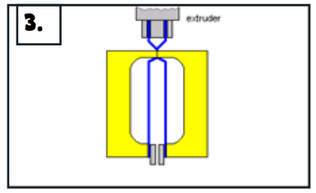
Process
The cycle starts with the mould open (1).



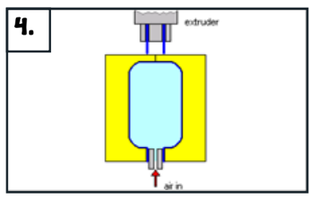
A hollow length of plastic, called a parison, is extruded down between two halves of the mould (2).



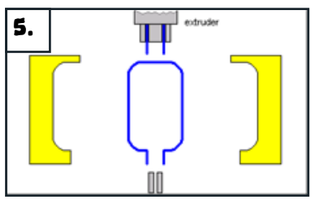
The mould closes and compressed air is blown into the Inside of the parison which inflates it, pushing the soft plastic Hard against the cold surfaces of the mould (3).



The plastic is cooled by the mould, causing it to harden quickly (4).



The mould is then opened, the moulding ejected and the Waste (called flash) is trimmed off with a knife (5).



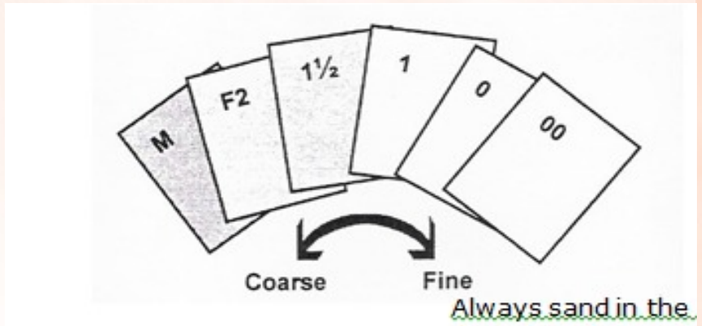
http://www.youtube.com/watch?v=7SvkDF6pkCE

THEORY finishes

Surface finishes

Wood

Before applying a finish it is important to make sure that the surface is very smooth and free from blemishes (marks and scratches) by firstly using an appropriate plane or scraper and then different grades of abrasive paper in the direction of the grain.



Sequence to applying varnish to a piece of wood

1. The Smoothing Plane (Smaller brother of the Jack Plane) is used first to remove pencil lines and any major blemishes.
2. Next, use a Medium grade of glass paper sand all surfaces.
3. The next stage is to apply a fine sprinkle of water over the surface of the wood. This raises the grains in the wood which when dry will be sanded off using a Fine Graded glass paper. This technique gives a better overall finish.
4. Using a Fine Graded glass paper sand down all surfaces.
5. Apply first coat of varnish. Allow to dry.
6. Using a Fine Graded gla
7. Apply second coat of va

Types of finish available

- Water Based Varnish
- Spirit Based Varnish
- Wax Polish
- Coloured Wax Polish
- Danish Oil
- Coloured Stains
- Paints

1.

2.

3.

4.

5.

6.

7.

THEORY finishes

Surface finishes/metals

The purpose of applying a finish to a piece of metal is to protect it from tarnishing or corrosion (rusting). Think of a metal artefact (say a bike) was to be constructed and left outside without any protective coating (paint), how long do you think it would take before it rusted? Not very long! Therefore metals have to be protected from rain, snow, etc. There is a number of ways of doing this depending on the type of metal being protected. The following examples are just some methods of protecting metals.

Painting
Paints are applied to bikes, garden gates, bridges, washing machines, etc because these artefacts are generally made from steel. Paints applied on metals come in various types and many colours.

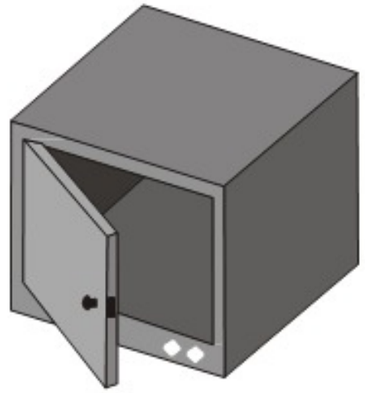
Lacquering
This is very similar to varnishing, it can be applied with a brush or can be sprayed on. The purpose of using this type of finish, is, if the base metal has a nice colour to it e.g. copper or brass, it allows this colour to be seen but at the same time protecting it.

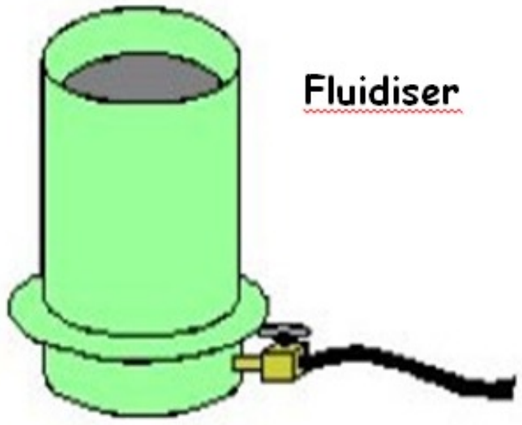
Bluing
This process involves heating the metal up and dipping it in a bath of oil, leaving it to cool and wiping dry with a cloth.

Plastic Dip Coating

A plastic coating is applied in the following way:-

1. Thoroughly clean and degrease the metal.
2. Heat the metal to 180^{O} degree C in an oven.
3. Dip the metal into the fluidised plastics powder for a few seconds.
4. Return it to the oven to fuse the coating to a smooth glass finish. Leave





Fluidiser

http://www.youtube.com/watch?v=EPqNYeQRsKY

HOMEWORK 1&2

Homework 1 - Metals

1. List or sketch five entirely different forms in which METAL can be supplied to the school workshop. **(5)**
2. Metals are usually classified as Ferrous and Non-ferrous. Explain what is meant by each of these terms. **(4)**
3. Name three safety features when using the pillar drill. **(3)**
4. What metal is used in the manufacture of a twist drill? **(1)**
5. What is the purpose of using a countersink drill? **(2)**
6. What is the purpose of the centre punch? **(2)**
7. In woodwork a try square is used to check wood for squareness, what tool is used to check metal? **(2)**
8. Explain briefly how an internal screw thread is cut in an internal hole. **(1)**

Homework 2 - Metals

1. When marking sizes etc. on wood a pencil is used, what tool is used to mark metal? **(1)**
2. There are two methods of filing a piece of metal/plastic name each. **(2)**
3. What is the name of the tool used to hold the TAP. **(1)**
4. Briefly explain what is meant by the term 'Tempering'. **(2)**
5. Briefly explain what is meant by the term 'Annealing'. **(2)**
6. Briefly explain what is meant by the term 'Heat Treatment'. **(2)**
7. Metals are usually classified as Ferrous and Non-ferrous. Explain what is meant by each of these terms. **(2)**
8. Callipers are used for testing the sizes of various articles, explain the difference between an inside calliper and an outside calliper. **(4)**

HOMEWORK 3&4

Homework 3

1. In the following table indicate with the means of a TICK whether the material listed is a ferrous metal or a non-ferrous metal. In the third column write down whether the metal is an alloy or a pure metal.

Material	Ferrous	Non-Ferrous	Alloy or Pure Metal
High Carbon Steel			
Brass			
Copper			
Duralumin			
Bronze			
Mild Steel			

(12)

2. Explain what an alloy is. Name three alloys? **(4)**

3. What is the maximum size of twist drill that can fit in a pillar drill. **(1)**

4. Name the two main parts of a TWIST DRILL. **(2)**

5. What is the purpose of a spring divider? **(1)**

Homework 4

1. Forging is the process of heating and shaping metals. What device is used to support the metal whilst the shaping is being carried out? **(1)**

2. Which tool is used to hold the metal whilst shaping is being carried out? **(1)**

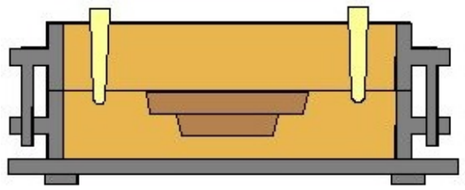
3. Which three tapping tools are used to make an internal screw thread and in which order are they used. **(3)**

4. What is the name of the tool used to hold the TAP. **(1)**

5. Explain briefly how an internal screw thread is cut in an Blind Hole. **(3)**

6. Briefly explain what is meant by the term 'Case Hardening'.

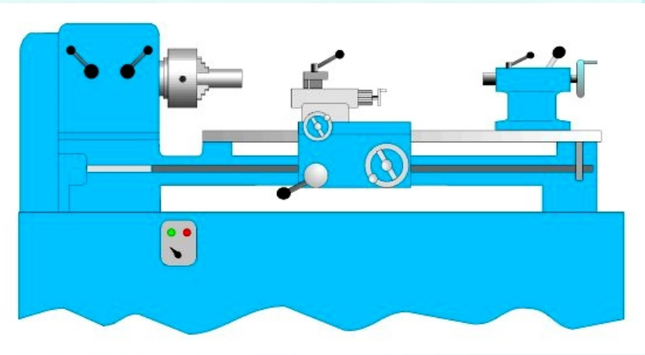
7. The device shown opposite is used in the process of casting. Name four of the component parts. **(2)**



HOMEWORK 5&6

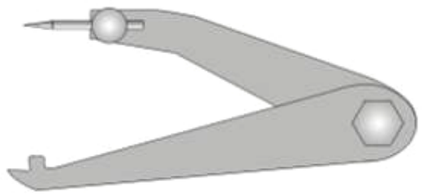
Homework 5

1. Sketch five entirely different forms in which METAL can be supplied to the school workshop. **(5)**
2. What is the name of the hand tool used to cut an external thread on a metal rod? **(1)**
3. Air holes are pushed through the sand into the space where the mould was positioned, why has this been done? **(2)**
4. In the sketch shown opposite, name any three component parts of the centre lathe. **(3)**
5. Name or sketch three types of rivet. **(3)**
6. Briefly explain what is meant by the term 'Heat Treatment'. **(2)**
7. Briefly explain what is meant by the term 'Annealing'. **(2)**



Homework 6

1. What are Spring Dividers used for? **(1)**
2. Sketch three types of rivet. **(3)**
3. Name the tool shown opposite and briefly describe what it is used for. **(3)**
4. When sand casting what is the purpose of the SPRUE PINS. **(2)**
5. When referring to casting, what two pieces of equipment are used to hold the sand. **(2)**
6. The purpose of sand casting is to create a shape in metal, what is the name of the piece of equipment used to push the shape into the sand before casting takes place? **(1)**
7. Briefly explain why the RUNNER and RISER are made when sand casting. **(2)**
8. Name the tool shown opposite and briefly describe what it is used for. **(2)**



HOMEWORK 7&8

Homework 7

1. Briefly explain the process "TAPER TURNING". Use a sketch if required **(2)**
2. Briefly explain the process "PARALLEL TURNING". Use a sketch if required. **(2)**
3. Briefly explain the process "FACING OFF". Use a sketch if required. **(2)**
4. Briefly explain the process "PARTING OFF". Use a sketch if required. **(2)**
5. List or sketch three file sections. **(3)**
6. Name the tools shown opposite. Briefly describe their purpose. **(3)**
7. Briefly explain what the process "KNURLING" is. **(2)**
8. Name two metal lathe cutting tools used to cut metal. **(2)**

Homework 8

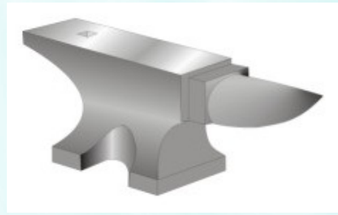
1. Briefly explain the process "BRAZING". **(2)**
2. Briefly explain the process "ELECTRIC WELDING". **(2)**
3. What mixture of metals (ALLOY) results in SOLDER. **(2)**
4. What mixture of metals (ALLOY) results in "BRAZING SPELTER". **(2)**
5. Name the type of tool shown opposite. **(1)**

6. The purpose of sand casting is to create a shape in metal, what is the name of the piece of equipment used to push the shape into the sand before casting takes place? **(1)**
6. Metals are usually classified as Ferrous and Non-ferrous. Explain what is meant by each of these terms. **(2)**
7. Briefly explain the process "PARTING OFF". **(2)**

HOMEWORK 9&10

Homework 9

1. Name the device shown opposite



(1)

2. Air holes are pushed through the sand into the space where the mould was positioned, why has this been done?

(1)

3. A plastic coat on metal will prevent it from rusting. Explain the four stages of applying the plastic coat to a piece of metal.

(4)

4. Name the type of hammer shown opposite.

(1)

5. When referring to metal, what properties would a metal have if it was said to be Ductile?

(1)

6. Name the process shown opposite

(1)

7. When referring to metal, what properties would a metal have if it was said to be Malleable

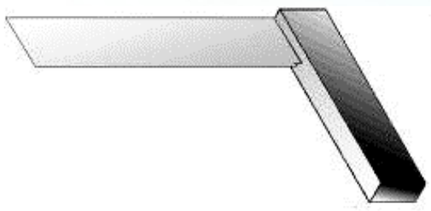
(2)

Homework 10

1. Name three safety features when using the pillar drill.

(3)

2. Briefly explain the difference between the junior hacksaw and the hacksaw.



(2)

3. Name the tool shown opposite and briefly describe what it is used for.

(2)

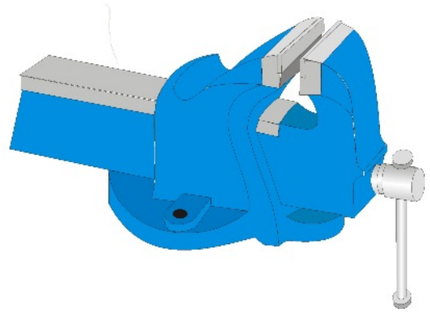
4. Name two techniques used to file a piece of metal and state which of the two techniques is carried out first.

(3)

5. Briefly explain what an ALLOY is.

(2)

6. Name the device shown opposite.



(2)

7. Name two non-ferrous metals.

(2)

8. Briefly explain what a Blind Hole is.

HOMEWORK 11&12

Homework 11

1. List three entirely different forms in which plastic can be supplied to the school workshop. **(3)**
2. Plastics are usually classified as thermoplastics and thermosetting plastics. Explain what is meant by each of these terms. **(4)**
3. In the table shown below indicate with a Tick which of the plastics listed are thermo or thermosetting. Also state their possible uses in everyday products. **(10)**

	Material	Thermoplastic	Thermosetting Plastic	Possible Use
Acrylic				
Epoxy Resin				
Polystyrene				
Phenolic Resin				
PVC				

4. What substance is the main source of Man-made Plastics? **(2)**
5. Briefly describe the process of BLOW MOULDING. **(4)**
6. Sketch a Junior hacksaw. **(2)**

Homework 12

1. Write a brief description of acrylic and state its commonly used trade name. **(2)**
2. Name two accessories which can be used when forming bends, folds and more complex shapes in acrylic. **(2)**
3. Name three tools used to cut acrylic. **(3)**
4. Name a type of plastic which when mixed with a catalyst is used to g;ue two pieces of material together. **(1)**
5. Sketch a Coping Saw. **(2)**
6. Briefly explain the process of EXTRUSION. **(4)**
7. Briefly explain the process of PRESS FORMING **(4)**

HOMEWORK 13&14

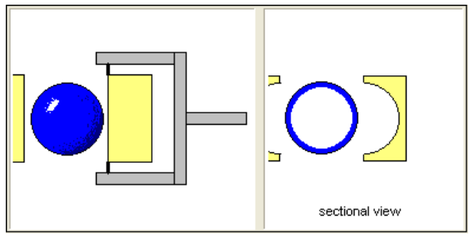
Homework 13

1. State two safety precautions which MUST be observed during the heating of acrylic in an oven or on a strip heater. (2) **(2)**
2. What two safety precautions should be observed when cutting and sanding plastics. (2) **(2)**
3. Sketch the three forms in which acrylic is supplied to the school workshop (3) **(3)**
4. Give a brief description of how a dish would be VACUUM FORMED. (4) **(4)**
5. When acrylic sheet is supplied to schools or industry, it is usually coated with white paper or a PVC film. What is the reason for this covering and explain briefly how a 100mm diameter circle could be marked out on a piece of acrylic sheet? (3) **(3)**
6. Explain the difference between thermoplastics and thermosetting plastics. (4) **(4)**
7. List three thermoplastics and three thermosetting plastics. (3) **(3)**
8. Briefly explain all the stages in the process INJECTION MOULDING. (4) **(4)**

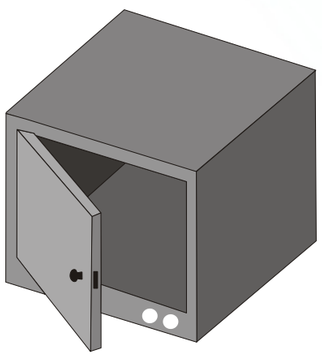
Homework 14

Name either the tools, equipment or processes shown below.

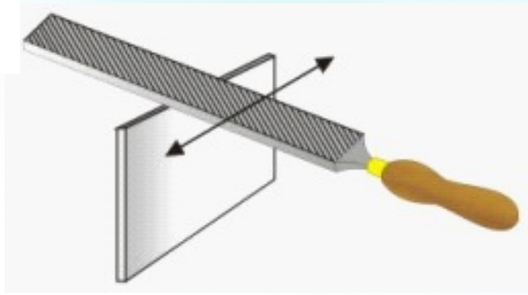
1.



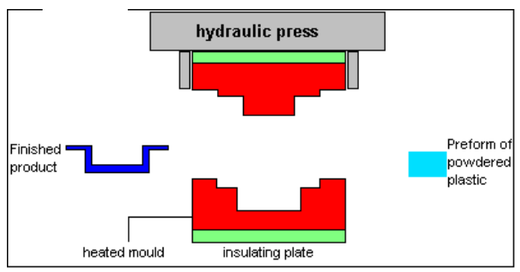
2.



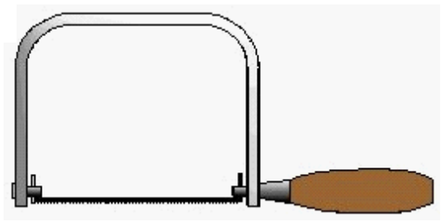
3.

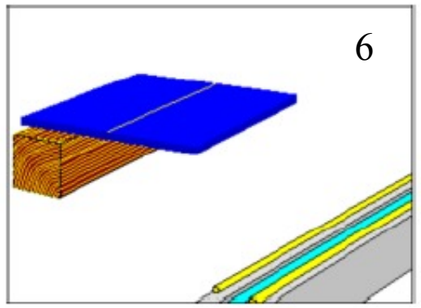


4.



5.





7

HOMEWORK 15&16

Homework 15

1. Explain what is meant by the term Plastic Memory. **(2)**
3. State a suitable polish for acrylic **(1)**
4. List three thermo and three thermosetting plastics. **(3)**
5. Explain the difference between thermoplastics and thermosetting plastics. **(4)**
6. The five stages used to finish the edge of a piece of acrylic are listed below in the wrong order. Using the corresponding letters write down the correct order. **(5)**

Correct Order

A	Use acrylic polish.	_ _ _ _ _ _
B	Cross file.	_ _ _ _ _ _
C	Draw file the edges.	_ _ _ _ _ _
D	Use wet and dry paper.	_ _ _ _ _ _
E	Buff with a clean cloth.	_ _ _ _ _ _

7. List two everyday products which could have been vacuum formed. **(2)**
8. State two safety precautions which MUST be observed during the heating of acrylic in an oven or on a strip heater. **(2)**

.....

Homework 16

1 Briefly explain the meaning of the term "Grain" when referring to timber **(2)**
2. Wood is classified into two groups name each. **(2)**
3. Name two types of hardwood. **(2)**
4. Name two types of softwood. **(2)**
5. Timber is supplied to the school workshops in different sized sections, sketch two types of section supplied to the workshop. **(2)**
6. Safety is of major importance in any workshop, list four safety rules which must be observed when working in the workshop. **(4)**
7. When referring to timber what is meant by the term finishing? **(2)**

HOMEWORK 17, 18&19

Homework 17

1. Name two types of finish which could be used on wood. **(2)**
2. Timber joints are used to join two pieces of timber together; name two factors which would determine what type of joint should be made. **(2)**
3. Sketch a Butt joint. **(3)**
4. Sketch a Dowelled joint. **(3)**
5. Why are very wide boards in softwood and hardwood very rare? **(2)**
6. In your answer to question number five how has this problem been overcome? **(2)**
7. Briefly explain how the man-made board Plywood is constructed. **(2)**

Homework 18

1. Sketch a Through Housing joint. **(3)**
2. Sketch a Stopped Housing joint. **(3)**
3. Briefly explain how Blockboard is constructed. **(2)**
4. Briefly explain how Chipboard is constructed. **(2)**
5. What is the most commonly used glue found in the school workshop and state how excess glue should be removed? **(2)**
6. Briefly explain the purpose of the cross pein hammer. **(2)**
7. Saw teeth are usually SET, briefly explain what is meant by this term and the reason for setting the teeth. **(1)**
8. What is the purpose of a hole saw? **(3)**

(1)

Homework 19.

1. Sketch a Through Housing joint. **(3)**
2. Sketch a Stopped Housing joint. **(3)**
3. Briefly explain how Blockboard is constructed. **(2)**
4. Briefly explain how Chipboard is constructed. **(2)**
5. What is the most commonly used glue found in the school workshop and state how excess glue should be removed? **(2)**
6. Briefly explain the purpose of the cross pein hammer. **(1)**
7. Saw teeth are usually SET, briefly explain what is meant by this term and the reason for setting the teeth. **(1)**
8. What is the purpose of a hole saw? **(1)**

HOMEWORK 20, 21 & 22

Homework 20

1. Name the two component parts of a Try Square. **(2)**
2. Briefly describe the purpose of a marking gauge and name two component parts. **(3)**
3. Name four types of man-made board. **(2)**
4. Sketch a Ratchet Brace giving a brief explanation of its purpose. **(3)**
5. Sketch a Claw Hammer giving a brief explanation of its purpose. **(3)**
6. Briefly explain how wood is categorised. **(2)**
7. Name a saw used for sawing awkward cuts in wood and state what is unique about this type of saw. **(2)**
8. Name two types of chisel found in the school workshop. **(2)**
9. Name the hammer used to hit chisels. **(1)**

Homework 21

1. What is the purpose of a mortise gauge? **(1)**
2. What is the most commonly used type of rasp found in the school workshop? **(2)**
3. What type of plane is used to trim end grain, mitres or interlocking grain? **(1)**
4. What is the purpose of a Sliding Bevel? **(1)**
5. State the name of the plane used to trim the bottom of housing joints to a set depth. What other name is this plane known by? **(1)** **(2)**
6. A Mitre Square is used to check angles, what are these angles? **(2)**
7. State two safety precautions which should be observed whilst working in the school workshops. **(2)**
9. Which joint would be ideal for joining the top rail of a table to the leg. **(1)**

Homework 22

1. Briefly explain what MDF is and how it is constructed. **(2)**
2. Name two safety rules which must be observed in the school workshop. **(1)**
3. When referring to timber what is meant by the term finishing? Name two types of finish which could be applied to wood. **(3)**
4 Briefly explain the meaning of the term "Grain" when referring to timber. **(2)**
5. Wood is classified into two groups name each. **(2)**
6. What plane could be described as being the smaller brother of the block plane and what type of planing is it used for. **(2)**
7. Timber joints are used to join two pieces of timber together; name two factors which would determine what type of joint should be made for the construction. **(2)**

HOMEWORK 23,24&25

Homework 23

1. Name two safety rules associated with the pillar drill. **(2)**
2. Briefly explain how the mortise machine cuts a square hole. **(1)**
3. What is the purpose of a face plate? **(2)**
4. Name and describe two tools used in conjunction with the wood turning lathe. **(4)**
5. State the purpose of the "G" cramp. **(1)**
6. Briefly explain what a wood turning lathe is used for. **(2)**
7. State the purpose of the Sash cramp. **(1)**
8. Name three parts of a wood turning lathe. **(3)**

Homework 24

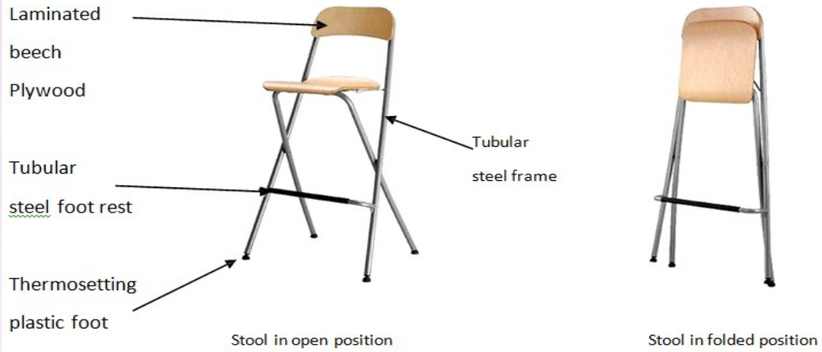
1. Name four wood turning chisels. **(4)**
2. Briefly explain the four stages when applying a coat of varnish. **(4)**
3. Describe a method of checking whether a frame carcase is square. **(4)**
4. What is the purpose of a Fret Saw? **(1)**
5. Explain the difference between a Rip Saw and a Cross Cut Saw. **(2)**
6. Name three types of nail. **(3)**
7. What is the purpose of creating a countersink in wood? **(3)**
8. Name the tool used to make a countersink hole. **(3)**

Homework 25

1. Describe the four stages in preparing a piece of timber for turning. **(4)**
2. What is the purpose of a Revolving Centre? **(2)**
3. What is the purpose of a Dead Centre? **(2)**
4. Briefly describe the purpose of a Marking Knife. **(2)**
5. In the space below make a sketch of the type of cut made by a Rebate plane. **(2)**
6. In the space below make a sketch of the type of cut made by a Plough plane. **(2)**
7. Where would a Spoke Shave plane be used? **(1)**

N5 HOMEWORK exam style 1

1. A folding kitchen stool is shown below.



Stool in open position

Stool in folded position

a) (i) State two reasons why tubular steel is a suitable material for the frame of the stool. **(2)**

(ii) State a suitable manufacturing process for the thermosetting plastic feet and state a reason why this process is suitable. **(2)**

(iii) State two reasons why laminated beech plywood is a suitable material for the seat and back of the stool. **(2)**

(iv) State a suitable method of permanently joining the steel foot rest to the frame and state a reason why this joining method is appropriate. **(2)**

b) Describe two ways in which the design of the stool has been influenced by ergonomics specifically anthropometrics; **(2)**

c) State two reasons why each of the following is important in the design of the stool: **(2)**

(i) surface finishes; **(2)**

(ii) safety; **(2)**

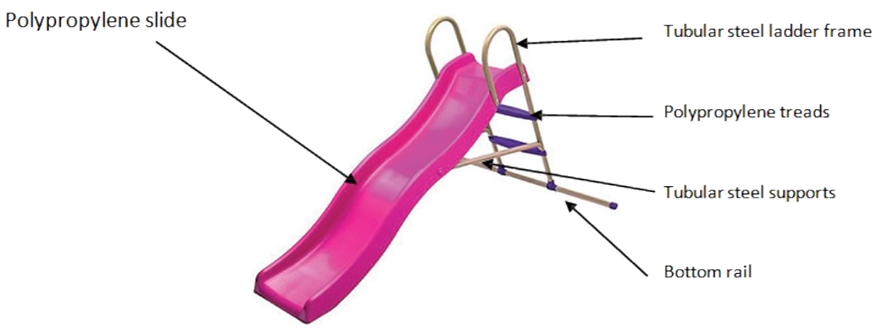
(iii) economics

(16)

HOMEWORK exam style 2

N5

2. A child's activity toy is shown below.



(a) (i) State two reasons why polypropylene is a suitable material for the slide. **(2)**

(ii) State two reasons why steel tube is a suitable material for the frame of the ladder. **(2)**

(iii) State a suitable finish for the frame of the ladder and state a reason why this finish is appropriate. **(2)**

(iv) State a suitable method of fixing the tubular steel supports to the polypropylene slide and state a reason why this fixing method is appropriate. **(2)**

(b) Describe two ways in which the design of the activity toy shown above has been influenced by ergonomics and anthropometrics **(2)**

(c)) Describe two ways in which the design of the activity toy shown above has been influenced by each of the following design issues: **(2)**

(*Note: different descriptions should be given for each design issue.*)

(i) safety; **(2)**

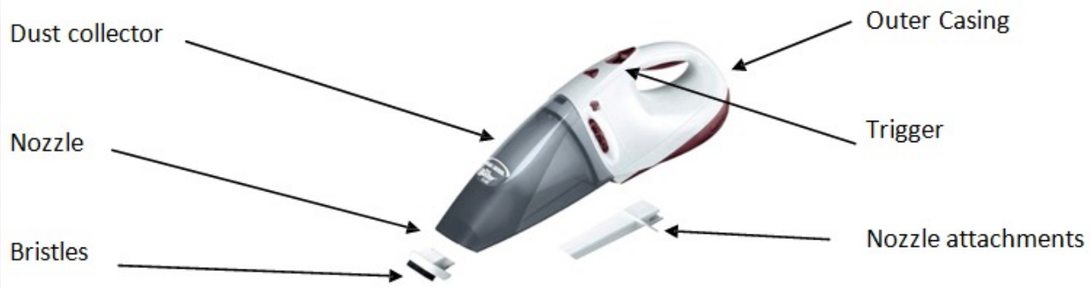
(Ii) durability;

(Iii) contrast.

(16)

N5 HOMEWORK exam style 3

A cordless vacuum cleaner is shown below.



(a) (i) State a suitable manufacturing process for the outer casing and justify your answer. **(2)**

(ii) State two reasons why the designer may have produced models when designing this cordless vacuum cleaner. **(2)**

(iii) State two reasons why plastic is a suitable material for the manufacture of the outer casing. **(2)**

(b) Describe two ways in which the design of the cordless vacuum cleaner shown above has been influenced by ergonomics and anthropometrics: **(2)**

(c) Describe two ways in which the design of the cordless vacuum cleaner shown above could have been influenced by each of the following design issues:

(i) contrast; **(2)**

(ii) consumer demand; **(2)**

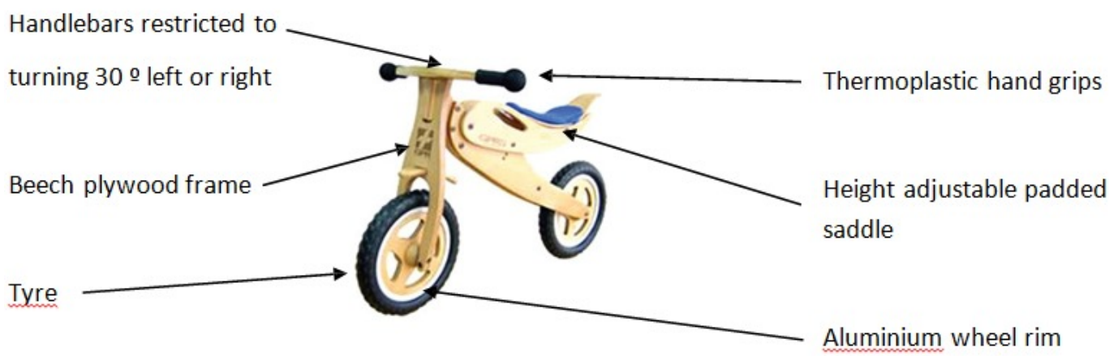
(iii) ease of maintenance. **(2)**

(14)

HOMEWORK exam style 4

N5

A mass produced wooden training bicycle for a 2–4 year old child is shown below.



(a) (i) State a suitable material for the tyres and state a reason why this material is suitable. (2) **(2)**

(ii) State two reasons why beech plywood is a suitable material for the frame of the bicycle. (2) **(2)**

(Iii) State a suitable process for manufacturing the plywood parts of the frame and state a reason why this process is suitable. (2) **(2)**

(iv) State a suitable clear finish for the frame and state a reason why a clear finish would be applied. (2) **(2)**

(b)) Describe two ways in which the design of the training bicycle shown above has been influenced by ergonomics and anthropometrics **(2)**

(c)) Describe two ways in which the design of the training bicycle shown above has been influenced by each of the following design issues: **(2)**

(i) function; (2) **(2)**

(ii) safety; (2) **(2)**

(iii) contrast (2)

(*Note: different descriptions should be given for each issue.*)

(16)

N5 HOMEWORK exam style 5

An ironing board is shown below.

(a) (i) State **two** reasons why tubular steel is a suitable material for the legs and feet of the ironing board. **(2)**

(ii) State a suitable manufacturing process for the thermoplastic end caps and state a reason why this process is suitable. **(2)**

(iii) State **two** reasons why manufactured board is a suitable material for the table of the ironing board. **(2)**

(iv) State a suitable method of joining the legs to the feet **and** state a reason why this joining method is appropriate. **(2)**

(b)) Describe how the design of the ironing board has been influenced by anthropometrics; **(2)**

(c)) Describe how the design of the ironing board has been influenced by each of the following design issues:

(i) function; **(2)**

(ii) safety; **(2)**

(iii) durability. **(2)**

(16)

HOMEWORK exam style 6

N5

6. A portable tool chest is shown below.

(a) With reference to the items shown: **(2)**

(i) state two reasons why mild steel sheet is a suitable material for the manufacture of the tool chest; **(2)**

(ii) other than painting, state two suitable protective finishes for the mild steel casing of the tool chest; **(2)**

(iii) state any suitable manufacturing process for the plastic wheel; **(2)**

(iv) state two reasons why plastic is a suitable material for the wheel; **(2)**

(v) state any process used in the manufacture of the mild steel wheel bracket. **(2)**

(b) Describe how the design of the tool chest has been influenced by anthropometrics; **(2)**

(c) Describe how the design of the tool chest could have been influenced by each of the following issues: **(2)**

(i) durability; **(2)**

(ii) function; **(2)**

(iii) safety. **(2)**

(20)

N5 HOMEWORK exam style 7

1. A selection of plastic trays from the inside of chocolate boxes is shown below.

(a)The plastic trays have been manufactured by vacuum forming. Explain why the following features are found on the pattern: **(2)**

(i) rounded corners; **(2)**

(ii) tapered edges; **(2)**

(iii) no internal slopes/curves.

(*Sketches may be used to illustrate your answers.*)

(b)The plastic trays are made from a thermoplastic.

Describe the main differences between thermoplastics and thermosetting plastics. **(8)**

HOMEWORK exam style 8

N5

2. A traditional garden trowel is shown below.

The garden trowel blade is made from stainless steel with the handle made out of wood. **(2)**

(a)(i) State a functional reason for the stainless steel blade **(2)**

(ii) State two possible methods of joining the handle to the blade i.e. look closely at joint. **(1)**

(iii) State 1 benefit for the manufacturer of making the product out of a Thermoplastic. **(3)**

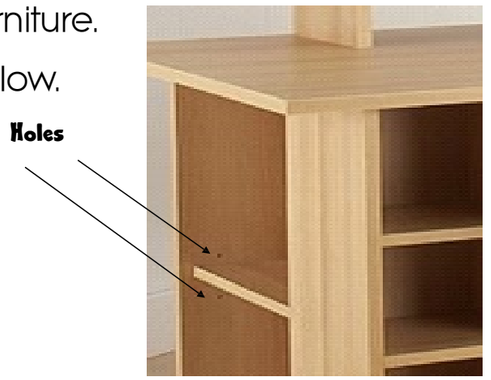
(b)State three advantages for the consumer of using thermoplastics for this type of product. **(8)**

N5 HOMEWORK exam style 9

3. The computer desk shown below was supplied as a flat-pack.

(a) State two advantages to the consumer of flat-packed furniture. **2**

(b)State the purpose of the holes identified in the picture below. **1**



(c) Knock down fittings are often used in the construction of flat-packed furniture. Explain the term "knock down fittings". **1**

(d)Explain 2 reasons why manufactured boards are more suitable for the construction of the furniture. **2**

(6)

HOMEWORK exam style 10

N5

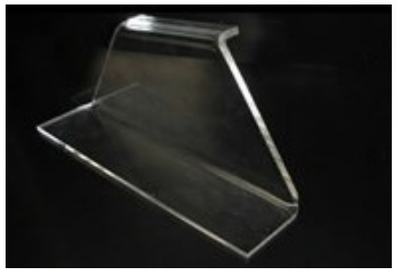
4. Six products are shown below with a list of manufacturing processes.

Match each product or part of product with the most suitable manufacturing process from the list.

A. Curtain Rail

C. Free Weights

B. Pine Table Leg



D. Thermosplastic book stand

E. Metal Shafts

F Plastic Cannon

Manufacturing Processes

Soldering
Wood Turning
Press-forming
Extrusion
Metal turning
Injection moulding
Sand casting
Laminating
Turning
Line Bending

N5 HOMEWORK exam style 11

1. I phone 5 , mobile phone.

a) With reference to the above phone, describe the *primary* and *a secondary function*. **2**

(b)Describe a technique that could be used to evaluate the *ease of use* of the phone. **2**

(c)Describe some *aesthetic* qualities of the phone. **2**

2.

(6)

(a) Explain how to secure a twist drill into this machine . **(2)**

(b)If the twist drill will not reach work piece explain how to adjust the table on the pillar drill **(2)**

(c) Name 4 safety precautions which should be followed when using this machine **(4)**

(d)Explain how to drill 20 mm into a piece of 40mm thick pine. **(2)**

(10)

HOMEWORK exam style 12

N5

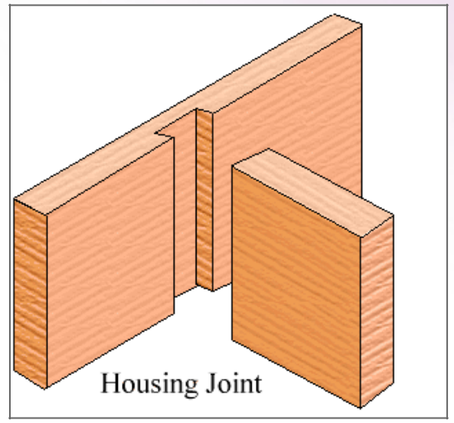
1. Children's Cutlery is shown below

During the design of children's cutlery, the designer would consider the following areas: *Ergonomics Safety Aesthetics Materials.*

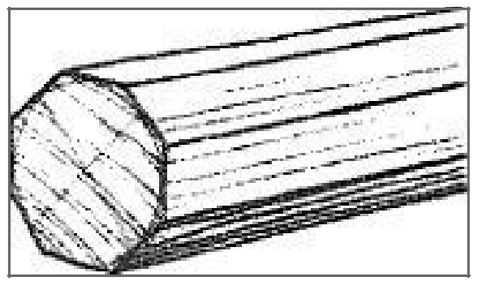
Explain why each of these areas is important in the design of children's cutlery. **(4)**

2.

(a) Explain how to mark out and cut a housing joint, you must attempt to include tool names and process steps required . You must attempt to record these in the correct order. **(4)**



b) Explain how to prepare a piece of wood for turning between centres. **(4)**



(12)

N5 HOMEWORK exam style 13

1. (a) Explain how to prepare and dip coat the handles for the spanners sho

(b) If the finish on the plastic after dip coating is dull and gritty explain the cause and how to rework product **(2)**

(c) Explain 2 reasons why the handle of the spanner is dip coated **(2)**

(d) Explain 2 pieces of Anthropometric data the designer may need to consider when designing the handle of the spanner. **(2)**

(e) Explain functional reasons why the materials chosen to make the spanner is important **(2)**

2. A typical classroom chair is shown in the photo.

(a)(i) State the name of a suitable material for the seat of the chair. **(1)**

(ii) Give two reasons why the material you have stated would be suitable for use in this type of product **(2)**

(iii) Explain 2 reasons why tubular steel is suitable for the frame of the chair **(2)**

(b) State a suitable manufacturing process that could be used to manufacture the seat of the chair **(1)**

(c) State 2 functions of the horizontal bars on the chair. **(2)**

(d) State 4 pieces of Anthropometric data that the designer would need to consider when designing the chair **(4)**

(20)

HOMEWORK exam style 14

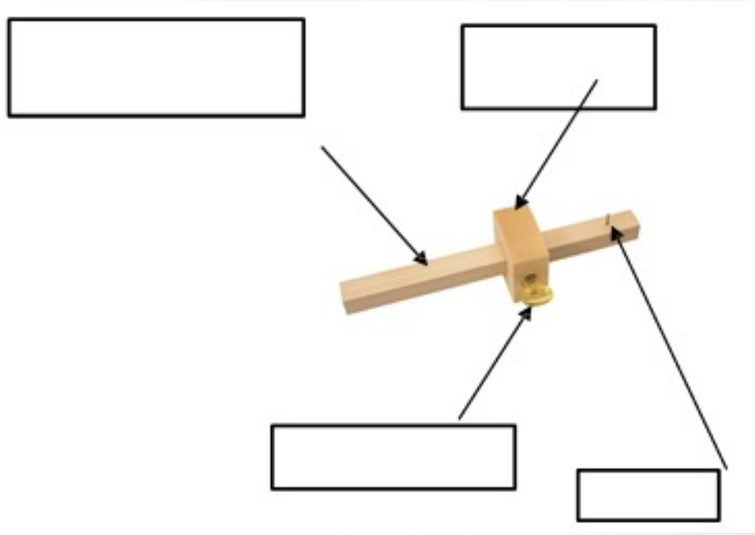
N5

1. Setting Woodworking Tools

(a) Tool Name.....

(1)

(b) Name the 4 main parts of this tool



(4)

(b)Explain how to set up this tool to 16mm.

(3)

(d) Tool Name .....

(1)

(e)Explain how to check this tool is set correctly and how to adjust the angle and depth of blade.

(3)

(12)

N5 HOMEWORK exam style 15

1 Write a step by step guide, on how to mark-out and cut the following wood joints.

Use sketches /text to help .

The description must include tool names used to mark out and cut the joints

(a) Joint Name.....

(1)

(b) Marking out-

(2)

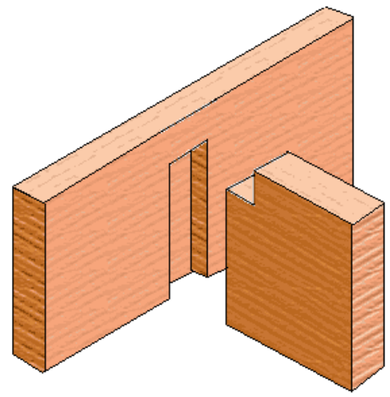
(c) Cutting-

(3)

(d) Joint Name.....

(1)

(e) Marking out-



(2)

(f) Cutting-

(3)

HOMEWORK exam style 16

N5

1. A claw hammer is shown below.

(a) State two reasons why the designer has chosen forged alloy steel for the head of the claw hammer. **(2)**

(B) State two reasons why the designer has chosen GRP for the shaft of the claw hammer. **(2)**

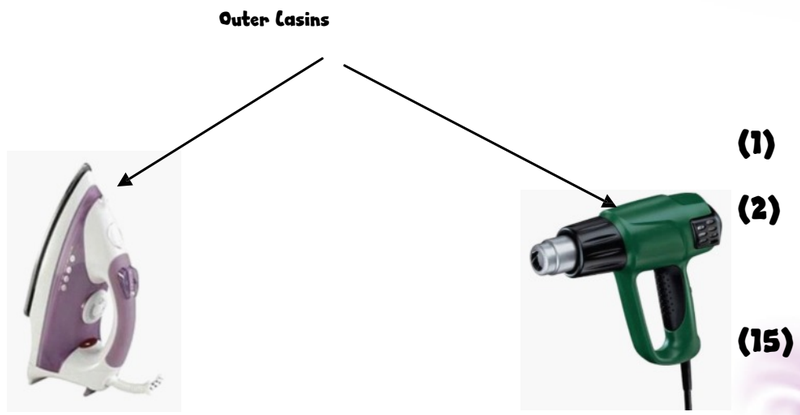
(c) Describe the appeal of the claw hammer to the consumer. **(2)**

2. The outer casings of the two products show below have been injection moulded.

(a) (i) State three features which would confirm that injection moulding is the manufacturing process used for the outer casings (3) **(3)**

(ii) State two advantages to the manufacturer of using injection moulding to produce the outer casings. **(2)**

(b) State how the designer could find out the correct sizes for the handles of the two products without referring to anthropometric data tables.



Both products were designed with planned obsolescence. **(1)**

C) i) State an advantage of planned obsolescence to the manufacturer. **(2)**

(ii) State two reasons why planned obsolescence is harmful to the environment. **(15)**

N5 HOMEWORK exam style 17

1. A traditional watering can is shown below.

The watering can is made from galvanised mild steel and brass. **(1)**

a) (i) State a functional reason for galvanising the mild steel. **(2)**

(ii) State two suitable methods of joining the handles to the body of the watering can.

Modern styles of watering can are usually manufactured from thermoplastics. **(3)**

(b)State three advantages for the consumer of using thermoplastics for this type of product.

(6)

HOMEWORK exam style 18

N5

1. The corner-shelving unit shown below is constructed from hardwood and is sold as a flat-pack

Plan of shelf showing curved shape

a) (i) State the name of a suitable manufacturing process for the spindles. **(1)**

(ii) Describe a method of joining the spindles to the shelves. (Sketches may be used to illustrate your answer. **(2)**

(iii) State the name of a power tool which could have been used to produce the curved shape of the shelves. **(1)**

(B) State two disadvantages to the consumer of flat-packed furniture. **(2)**

(c) State two reasons why using a softwood would be more environmentally friendly than using a hardwood. **(2)**

(d) State the name of two suitable finishes that could be applied to the hardwood. **(2)**

(10)

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COURSE MATERIAL

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